JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

JANUARY, 1852.

CIVIL ENGINEERING.

*Extract from the Report of the General Board of Health respecting the Metropolis.—Water Supply and Drainage of Towns.**

The Board have inquired fully into that essential point—What are the qualities of water the most conducive to health, and to economical employment for domestic and manufacturing purposes?

On this question the Board refer to a great mass of evidence; and first, as to the effect of lime contained in water.

It cannot be gathered from the evidence that, excepting in calculous disorders, a small quantity of lime in water has been *proved* to be injurious to health, though it has always been suspected of being insalubrious, and is thought to be so by many of the witnesses.

The Report states that Professor Clark has invented the term of *degrees of hardness;* this will doubtless be found to be of great practical convenience. One degree of his lime scale, as it may be called, denotes that one grain of carbonate of lime is contained in a gallon of water; the several higher degrees of hardness denote that for as many as are the degrees marked, so many are the grains of carbonate of lime contained in each gallon of water.

That lime injures water for all economical purposes is fully proved, as also for most manufacturing processes, "but the natives of London are very little aware of it." We find no attention paid to it in any of the "schemes for water supply which have obtained the aid of parochial Boards."

Hardness is unfavorable to all culinary operations; thus, according to

* From the London Mechanic's Magazine, for September, 1851.

M. Soyer's evidence, hard water gives a yellow tinge to vegetables boiled in it, and gives them a shrivelled appearance. Hard water "does not open the pores of meat so freely as soft water does." Infusions of all kinds are stronger when made with soft water than with hard; so that tea made with water of 6½ degrees of hardness requires nearly a third less of the tea than when made with water of 16 degrees of hardness, being about that of Thames water. This evidence was corroborated by that of Mr. Philip Holland and of Professor Clark. Hard water requires more fuel than soft to raise it to a boiling heat. Hard water occasions greater expense than soft in washing, on several accounts; as the greater quantity of soap or of soda required, the extra labour in washing, the greater wear and tear of the clothes themselves. "As far as the home market is concerned," "more money is expended in washing than in the manufacture of the fabric, or of the clothes themselves." In London, "before a shirt is worn out, five times as much money as it originally cost will have been expended on it in washing." The alkalies and mineral ingredients used in washing with hard water never fully leave the clothes.

The data on which the Board calculate the expense of mere washing are the only ones throughout the whole Report that appear to be erroneous; in this instance they seem to be so, because the prices stated for washing—whether by the piece, or from the weekly average expenditure of individuals or families—are not for washing alone, but include the charge for expenses incurred in collecting linen, drying, and folding it, mangling some of the articles, ironing several of them, starch, blue, &c.; which items constitute together at least half the expense of laundry-work. The oversight in this respect does not, however, invalidate the strong testimony given of the increased cost on several accounts occasioned by washing in hard water.

From Mr. Donaldson's evidence, it appears that for every 100 gallons of water used, 2 oz. of hard soap are required to soften it for each degree of hardness; thus water of 5° of hardness requires 10 oz. of soap; if the water be of 15° of hardness, 30 oz.

The amount of the money expended for washing in the metropolis was another inquiry. According to one estimate the washing bills in London rise to the enormous sum of 5,000,000*l.* a year, at the average rate of little more than a shilling a head per individual for the whole population. This the Board seem to think excessive,—and, indeed, it appears to be so; the masters in some families may, indeed, spend even more than five shillings a week in laundry work, as specified in the calculations; but the laundry expenses of the greater portion of the industrious classes do not amount to more than sixpence a head a week,—and this description of persons form the great bulk of the metropolitan population.

Soft water is more agreeable and effective than hard for baths, and for all purposes of the toilette. Several witnesses affirm that, as a beverage soft water is more agreeable than hard; though those accustomed to hard water become reconciled to its use.

There are many manufactures that cannot be advantageously carried on with hard water; hence several of the great London brewers have, at a heavy outlay, caused deep wells to be dug on their premises for the purpose of obtaining water that is soft.

The water of the Thames supplied to London is stated to be of from 14 to 16 degrees of hardness, and that of the other rivers and streams which contribute to the supply of London is about equally hard. The Board have had 424 different specimens of water tested; they were taken from different distant places. Water from wells and springs averaged nearly 26 degrees of hardness; that from rivers and brooks 13 degrees; that from land and surface drainage not quite 5 degrees. About 26 tons of lime are delivered in the metropolis *daily*, mixed or dissolved in the water with which it is supplied.

Professor Clark has indicated an economical means of depriving water of its carbonate of lime by means of quick lime; and Mr. P. Holland describes a mode of farther purifying it by the addition of "a little oxalate of ammonia, or of soda."

A mixture of other inorganic impurities in water, such as iron, or clay, is prejudicial for all economical purposes; but, excepting after floods, being seldom found in considerable quantity in any of the waters with which towns are supplied, little notice is taken of such impurities.

The Board's inquiries respecting organic impurities are extensive and important. By the information they have elicited, it does not appear that animals and vegetables usually inhabiting water are, whilst in a *living* state, insalubrious; but that, when in a state of decomposition, they render water containing them highly injurious to health. The evidence on this head proves the fact incontestibly. Organic matters, when in that state, produce disease taken internally as a beverage, and also when the gases arising from them are inhaled. A remarkable instance of the former is given by Dr. Gavin:—"A thirsty navigator drank of the Hackney brook, and was almost immediately attacked with cholera, and subsequently speedily died." The instances adduced are innumerable of the deleterious effects of the emanations from water rendered putrid by the decomposition in it of organic matter; but "chemistry has not to the present moment succeeded in isolating those substances, or in characterizing them by particular reactions." Water got at Hungerford market contained in a gallon above 13 grains of volatile and organic matter in suspension, besides 43 grains of inorganic matter. When that water was boiled down, it emitted a strong acid smell, and when heated, a smell like that of burning wood. Exclusively of epidemic periods, "in ordinary times it is known that troops who have drank water polluted with animal or vegetable matter in a state of decomposition are peculiarly subject to dysentery."

The *boiling* of water appears to greatly diminish the deleterious effects of such water. "There was the case of a man who lived in the Coburg-road, Camberwell parish, in a semi-detached house, in a healthy situation, and with a garden behind the premises. His wife had noticed that the water supplied to them was exceedingly bad; and having been informed that it was likely to affect the health of her family, she invariably boiled and filtered it. All kept in perfect health except the father, who objected to drink this water from its being flat and unaërated: he would still drink it as it came from the water-butt, and the consequence was that he was attacked with choleraic diarrhœa; he afterwards drank no more of it, and got well."

It is shown that lead is more corroded by pure than by impure water; but it has been unexpectedly found that filtration through sand separates the lead.

These preliminary inquiries having been gone through, as to the economical and the sanitary qualities of different waters, the next question to be considered is, From what source can London be supplied with water that shall be the most free from vitiating matters?

The Board report, that "The qualities for the water supply of the population appear to range themselves in the following order:

"1st, Freedom from all animal and vegetable matter.

"2d, Pure aëration.

"3d, Softness.

"4th, Freedom from earthy, mineral, or other foreign matters.

"5th, Coolness in delivery at a minimum temperature,—neither warm in summer nor excessively cold in winter.

"6th, Limpidity or clearness."

To the above are added, as popular tests, that all special flavor or taste in water is objectionable.

A great mass of evidence is brought forward in proof that the streams from which London is supplied with water, *before* they come to be charged with sewer-water, already contain a vast quantity of animal and vegetable matter; that it is not any one of those streams but all of them, that are polluted with it,—the Thames itself to an excessive degree. That though the Thames and its tributaries be largely derived from land-springs through chalk strata, their water is in a turbid state when delivered, much of this turbidity being occasioned by animal and vegetable matter so completely in chemical solution that the common filters will not remove it; and it appears that the water of the New River, and of the water companies generally, is also charged with impurities of the same nature.

"We must state, as our conclusions upon this topic of inquiry, that if the water of the Thames could be early protected from the sewerage of all the towns draining into it, and from the sewerage of the metropolis, —if it could be purified from animal and vegetable matter as completely as deep well water, or as some of the surface water from the chalk districts, as proposed by Captain Vetch,—we should nevertheless feel compelled, upon the evidence recited, to pronounce water of such degrees of hardness to be ineligible for the supply of the metropolis, and to recommend as we now do,—"That the water of the Thames, the Lea, the New River, the Colne, and the Wandle, as well as that of the other tributaries and sources of the same degrees of hardness, should be as early as practicable abandoned.

"Deep well-water is free from surface animal and vegetable impurities, but it has generally more of mineral impurity, and is usually unobtainable in sufficient quantity at a moderate expense."

Since the number that has been made of deep wells in the metropolis of late years, it seems certain that the supply from this source would be inadequate to the wants of London. Already great brewers have arranged amongst themselves to brew respectively on different days, so as to equalize the demands on the water-bed; it is further stated that water is higher

in the wells on Mondays than on any other days, by reason of there being no brewing on the Sunday. This difference in the level of the water-bed is felt as far from town as Tottenham.

"Seeing the disadvantages inseparable from river and well-water, attention has been directed to other sources of supply." Professor Clark states that "nowhere has there been made such important improvements in the collection and purification of water supplies as in Lancashire."

"The improvement in the collection is due to the application of the principle we have above stated; that is to say, that the nearer to the actual rain fall the water is collected, the freer it will be from adventitious impurities. The new practice in Lancashire has been to take some elevated ground,—generally sterile moor land, or sandy heath; and to run a catch water trench or conduit round the hill, midway, or as high up as may be convenient for the sake of fall, regard being had to the space of the gathering-ground. An embankment is thrown across some natural gorge, at the nearest point at which a reservoir may be formed without the expense of excavation. Into this the rain water is led, and stored, to be used in dye or print works, or for other manufacturing purposes, having in many instances been previously filtered. The economy and efficiency of these filters, which merely act as strainers, are much praised by Professor Clark. They serve to show, however, how much more economically filtration may be conducted on a large than on a small scale; and how sordid and erroneous is the administration, whether of water companies, or of local Boards, which neglects or refuses filtration of the supplies used for the general population. But until recently, with the exception of a very small proportion, the supply of towns was delivered without any previous filtration whatsoever, and more than half the supply of the metropolis is still so delivered.

"The new process of land-drainage furnishes a means for the filtration and depuration of impure water on a large scale, with considerable advantages over the larger sand strainers or common filters." "Where the drains have been tolerably well adjusted, the water from this deep drainage is seen running away perfectly pellucid. Where there happen to be two branch outfalls into one main,—the one a branch outfall from mere surface drained land, the other an outfall from thorough drained land,—the water from the thorough drained land may be seen running perfectly limpid, whilst the water from the surface drained land runs away turbid, and of the color and consistency of pea-soup, from the inorganic or organic particles which it contains."

The Board caused to be tested 424 specimens of water from different parts of the country. The results were as follows:

From wells and springs, average hardness,	25·86
" rivers and brooks, average hardness,	13·05
" land and surface drainage, average hardness,	4·94

The Board were early desirous of investigating what matters were taken up by water passing through different sorts of soils, but the College of Chemistry declined the task; lately, however, "the examination has been made by Professor Way, with most important results." From this examination it will be seen, that clays and loams have powers of chemi-

cal action for the removal of organic and inorganic matters from water to an extent never before suspected, and that it will be practicable to use agricultural drainage arrangements on gathering grounds, as means of filtration and more complete purification of water on a larger scale than is at present accomplished."

To be Continued.

On Ventilation by the Parlor Fire. By WILLIAM HOSKING, ESQ., *Professor of Architecture and of Engineering Constructions at King's College, London.**

The term ventilation does not strictly imply what we intend by its use in reference to buildings used as dwelling-houses, or otherwise for the occupation of breathing creatures. To ventilate is defined "to fan with wind;" but one of the main objects for which houses and other enclosed buildings are made, is shelter *from* the wind. Inasmuch, however, as the wind is but air in motion, and we can only live in air, air may not be shut out of our houses, though, for comfort's sake, we refuse to admit it in the active state of wind. But in doing this—in shutting out the wind—we are apt to put ourselves upon a short allowance of air, and to eke out the short allowance by using the same air over and over again.

There is a broad line of distinction, indeed, to be drawn between in-door and out-door ventilation; for although the principles upon which nature proceeds are the same, the operation is influenced by the circumstances under which the process may be carried on. Whether it be on the hill-side, open to the winds of heaven, or in a close room, from which all draft of air is excluded, the expired breath, as it leaves the nostrils heated by the fire in the lungs, rises, or seeks to rise, above their level, and may not be again inhaled. Out of doors the cooler or less heated air of the lower level presents itself for respiration unaffected by the spent exhaled air, but in a close apartment, the whole body of included air must soon be affected by whatever process any portion of it may have undergone. The process by which nature carries off spent air, purifies, and returns it uncontaminated, is thus checked by the circumstances under which we place ourselves within doors. All our devices for shelter from the weather, and for domestic convenience and comfort, tend to prevent the process provided by nature from taking effect according to the intention in that respect of the Creator. We not only confine ourselves, indeed, and pen up air in low and close rooms, but we introduce fire by which to warm the enclosed air; wanting light within our dwellings when daylight fails, we introduce another sharer in the pent-up air of our rooms, being fire indeed in another form, but generally under such circumstances, that it not only abstracts from the quantity, but injures the quality of what may remain. But fire, whether in the animal system, in the grate, or in the lamp, cannot long endure the imagined limitation of air. There must be access of air—of vital air—by some channel or other, or the fire will go out.

* From the Edinburgh New Philosophical Journal, October, 1851.

An open fire in the grate must however have a vent for some of its results, or it will be so disagreeable a companion that its presence could not be endured, even as long as the most limited quantity of air would last; and the fire will compel the descent of air by the vent commonly supplied under the name of a flue—a chimney flue—to render its presence tolerable in a closed room, if a supply be not otherwise obtainable. But as the outer air at the higher level of the top of a chimney, because of the rarity of the air in and above the flue, responds to the demand of the fire less easily than the lower air, or that at and about the level of the fire; and the lower air, or air at the lower levels, forces its way in, therefore, by any opening it can find or make—through the joints of the flooring-boards, and under the skirtings—the supply passing first up or down the hollow lathed and plastered partitions, sometimes even up from the drains; and through the joints under and about the doors and windows. If these channels do not exist, as they may not when the joiners' work and the plastering are good, or when the open joints referred to are stopped up by any means, the fire smokes, and every known means of curing the chimney failing, means are sought of obtaining heat without the offending fire. Ventilation is not thought of yet.

The open fire may be made to give place to the close stove or to hot-air pipes, to hot-water pipes, or to steam-pipes—which make hot the air about them in a close room without causing drafts. But the warmth obtained in pipes is costly under any circumstances. Air does not take up heat freely, unless it be driven and made to pass freely over the heated surface; and there being little or no consumption of air, and consequently little or no draft, in connexion with heated bodies, such as close stoves and hot pipes, the heat from them is not freely diffused, and is not wholesome. There is with all the expense no ventilation.

Stoves and hot pipes are, moreover, exceedingly dangerous inmates in respect of fire. Such things are the most frequent causes, directly or indirectly, of fires in buildings. Placed upon, or laid among or about the timbers and other wood-work of hollow floors, and hollow partitions, and in houses with wooden stairs, more conflagrations are occasioned by hot pipes and stoves, than by anything else, and perhaps more than by all other things together.

Open stoves with in-draft of air warmed by being drawn quickly (when it is drawn quickly) over heated surfaces, may be made part of a system of safe and wholesome in-door ventilation; but to be perfect there must be also out-draft with *power* to compel the exit of spent or otherwise unwholesome air. But the arrangements for and connected with such stoves are special, and therefore costly, unless the buildings in which they may be employed have been adapted in building to receive them. And in-draft stoves may, however, be applied with great advantage as it regards the general warmth and ventilation, in the lowest story of any house, if there be compelled out-draft at the highest level to which it will naturally direct itself if it be not retained, so that the in-drafted air, tempered as it enters, may be drawn out as it becomes spent, or otherwise contaminated.

But this must be considered in all endeavors to affect in-door ventilation, or the endeavor will fail. *The air must be acted upon, and not be*

left, or be expected, to act of itself, and to pass in or out as may be desired, merely because ways of ingress and egress are made for it. Make a fire in a room, or apply an air-pump to the room, and the outer air will respond to the power exerted by either by any course that may be open to it, and supply the place of that which may be consumed or ejected; but open a window in an otherwise close room, and no air will enter; no air can enter, indeed, unless force be applied as with a bellows, whereby as much may be driven out as is driven in, with the effect only of diluting, not of purifying. Even at that short season of the year in which windows may be freely opened, unless windows are so placed as to admit of the processes of out-door ventilation being carried on through them by a thorough draft from low levels to high levels, open windows are not sufficient to effect thorough in-door ventilation. There must for this purpose be in every room a way by which a draft can be obtained, and this draft must take effect upon the most impure air of the room, which is that of the highest level. The chimney opening may supply a way at a low level, and a draft may be established between it and the window, but the air removed from the room by such a draft is not necessarily the spent or foul air. But make an opening into the chimney flue near the highest level in the room, that is to say, as near as may be to the ceiling, and if a draft be established between the window and the flue by this opening, the ventilation is complete; that is to say again, if there be draft enough in the chimney flue from any cause to induce an up-current through it, or if there be motion of the external air to drive the air in at the window and force an up-current through the flue.

Windows may not be put open in the long enduring colder season, however, and for the same reason in-drafts of the outer air by any other channel are offensive and injurious. To open a door for the sake of air is but a modification of opening a window, and, if the door be an internal one, with the effect of admitting already enclosed, and, probably, contaminated air. Means of efficient in-door ventilation must therefore be independent of windows and doors; and the means should be such as will lead to a result at once wholesome and agreeable.

Many plans have been suggested, and some have been carried into effect, of warming air, and then forcing it into or drawing it through buildings, and, in the process of doing so, removing the foul or spent air from the apartments to which it may be applied. Some of these plans are more and some are less available to wholesome and agreeable in-door ventilation, but even the best are rather adapted to large apartments, such as those of hospitals, churches, theatres, and assembly-rooms, than to private dwelling-houses in which the rooms are small and labor and cost are to be economized.

Plans have been proposed, too, for the economical ventilation of dwelling-houses; but they seem to be all in a greater or less degree imperfect. Ways of access are provided in some cases for the outer air directly to the fire in every apartment, to feed the fire, and indirectly to ventilate the room; way of egress in addition to the chimney opening and the chimney flue being sometimes provided for the spent air of the room; sometimes, indeed, as before indicated, by an opening into the chimney

flue near the ceiling. A direct in-draft of cold air is not agreeable, and it may be pernicious, but if the outer air become warm in its way to the inmates of the room, the objection to its directness ceases. If, however, the warmth is imparted to it with foulness, the process does not fulfil the condition as to wholesomeness, and this is the case, when the outer air is admitted at or near to the ceiling to take up warmth from the spent and heated atmosphere of the higher levels. Having undergone this process, it is not the fresh air that comes warmed to the inmates, but a mixture of fresh and foul air that cannot be agreeable to any inmate conscious of the nature of the compound.

The endeavor on the present occasion was to show how the familiar fire of an apartment may be made to fulfil all the conditions necessary to obtain in-door ventilation, to the extent at least of the apartment in which the fire may be maintained, and while it is maintained.

A fire in an ordinary grate establishes a draft in the flue over it with power according to its own intensity, and it acts with the same effect, at least, upon the air within its reach, for the means which enable it to establish and keep up the draft in the flue. The fire necessarily heats the grate in which it is kept up, and the materials of which grates are composed being necessarily incombustible, and being also ready recipients and conductors of heat, they will impart heat to whatever they may be brought into contact with them.

It is supposed that the case containing the body of the grate is set on an iron or stone hearth in the chimney recess, free of the sides and back except as to the joints in front. Let all communication between the chamber so formed about the back and sides of the grate and the chimney flue be shut off by an iron plate, open only for the register flap or valve over the fire itself. External air is to be admitted to the closed chambers thus obtained about the grate by a tube or channel leading through the nearest and most convenient outer wall of the building and between the joists of the floor of the room, to and under the outer hearth or slab before the fire, and so to and under the back hearth in which sufficient holes may be made to allow the air entering by the tube or channel to rise into the chamber about the fire-box or grate. Openings taking any form that may be agreeable are to be made through the cheeks of the grate into the air-chamber at the level of the hearth. In this manner will be provided a free inlet for the outer air to the fire-place and to the fire, and of the facility so provided the fire will readily avail itself to the abolition of all illicit drafts. But the air in passing through the air-chamber in its way to the fire which draws it, is drawn over the heated surfaces of the grate, and it thus becomes warmed, and in that condition it reaches the apartment.

An upright metal plate set up behind the openings through cheeks of the grate, but clear of them, will bend the current of warmed air in its passage through the inlet holes, and thus compel the fire to allow what is not necessary to it to pass into the room; and if the opening over the fire to the flue be reduced to the real want of the fire, the consumption of air by the fire will not be so great as may be supposed, and there will remain a supply of tempered air waiting only an inducement to enter for the use of the inmates of the apartment. An opening directly from the

room into the flue upon which the fire is acting with a draft more or less strong, at a high level in the room, will afford this inducement; it will allow the draft in the flue to act upon the heated and spent air under the ceiling, and draw it off; and in doing so will induce a flow of the fresh and tempered air from about the body of the grate into the room.

The mode thus indicated of increasing the effect of the familiar fire, and making it subservient to the important function of free and wholesome ventilation, is not to be taken as a mere suggestion, and now for the first time made. It has been in effective operation for six or seven years, and is found to answer well with the simple appliances referred to. But it is the mode and the principle of action that it is desired to recommend, and not the appliances, since persons more skilled in mechanical contrivances than the author professes to be, may probably be able to devise others better adapted to the purpose.*

The mode referred to of warming and ventilating apartments by their own fires is most easy of application, and in houses of all kinds, great and small, old and new, and as the warmth derived from the fire in any case, comes directly by the in-drafted air, as well as by radiation of heat into the air of the apartment, fuel is economized. If the register flap be made to open and shut, by any means which give easy command over it, so that it may be opened more or less according to the occasion, and this be attended to, the economy will be assured; for it is quite unnecessary to leave the same space open over the fire after the steam and smoke arising from fresh fuel have been thrown off, as may be necessary immediately after coaling. The opening by the register valve into the flue may be reduced when the smoke has been thrown off, so as to check the draft of air through the fire, and greatly to increase the draft by the upper opening into the flue, to the advantage of the ventilation and to the saving of fuel, while the heat from the incandescent fuel will be thereby rather increased than diminished.

Moreover the system being applicable in the cottage of the laborer, as fully and easily as in the better appointed dwellings of those who need not economize so closely as laboring people are obliged to economize, the warmed air about the grate in a lower room may be conveyed directly from the air-chamber about the grate by a metal or pot pipe, up the chimney flue, and be delivered in any upper room next to the same flue and requiring warmth and ventilation, the process of ventilation applied to the lower room being applicable to the upper room also.

The indicated means by which winter ventilation is obtained are not of course equally efficient in summer, for the draft of the fire is wanting; but the inlet at the low level for fresh air, and the outlet for the spent air at the upper level continuing always open, the heat which the flue will in most cases retain through the summer aided by that of the sun's rays upon the chimney top, secures a certain amount of up-draft, which is not without its effect upon the in-draft by the lower inlet even when windows and doors are shut.

While it is obvious that the air drawn into any house for the purpose

* The appliances used by Mr. Hosking will be found more fully described in his "Healthy Homes," published by Mr. Murray.

of in-door ventilation need not be other than that which would enter by the windows of the same house, it may be necessary to enter into an inquiry as to the condition of the air heretofore spoken of as fresh and pure. "Fresh" and "pure" applied to air must be taken to mean the freshest and purest immediately obtainable, and that will be the same whether it be drawn in through a grated hole in a wall, or by a glazed opening closed by it in the same wall. But it is a fair subject for inquiry, whether,—speaking in London to Londoners,—the air about our houses in London is as pure,—or as free from impurity—as it might be.

The out-door ventilation of large towns may be taken to be more complete above the tops of the houses and of their chimneys than it is, or, perhaps, can be among and about the houses. The processes of nature are there not only unchecked, but are in fact aided by the heat thrown up by the chimneys into the upper air, and impurities which can be passed off by chimney flues, will be more certainly and more effectually removed and changed by Nature's chemistry, than if they are kept down to fester under foot and to exhale in our streets and about our doors and windows.

At this time every endeavor is made to provide for removing from our dwellings all excrementitious matter, and all soluble refuse, by drains into sewers, and so by the sewers to some outfall for discharge. The drain necessarily falls towards the sewer, and the sewer again to its outfall, and the sullage or soil drainage being rendered liquid thus passes in the usual course. But the usages and the necessities of civilized life cause a large proportion of the liquid refuse from dwelling-houses to pass off in a heated state, or to be followed by hot water arising from culinary processes, and from washing in all its varieties. The heat so entering the drains causes the evolution of fetid and noxious gases from the matters which go with, or have gone before, the hot water; and with these gases house-drains almost always, and sewers commonly stand charged. They are light fluids, and do not go down with the heavy liquid matters from which they have been evolved, but they seek to rise, and constantly do rise in almost every house through imperfections or derangements of the flaps and traps which are intended to keep them down, but which only, when they do act, compel some of the foul air to enter the sewers, and there to seek outlet to the upper air, which they find by the gulley gratings in the streets.

It can hardly be said perhaps that *too much* attention has been given of late to the scour of sewers by water; but it is most certain that too little attention has been given to the consideration last stated, for nothing has been done to relieve the drains and sewers of their worst offence. The evolution of foul and noxious gases in the *drains* is certainly not prevented by scouring the *sewers*. In the meantime the poison exists under foot, and exudes at every pregnable point within and about our houses, and it rises at every grating in our streets, though the senses may become dull to them by constant suffering.

Now this is an evil which can be greatly ameliorated, if it cannot indeed be wholly cured; but it is by a process that, to be effective, must be general, and, therefore, it must be added compulsory. The process is of familiar application in the ventilation of mines, and particularly of

coal mines. An up-cast shaft containing a common chimney flue carried up at the back of every house, and connected with the house-drains at their highest level, would give vent to the foul air in the drains, and discharge it into the upper air. The foul air evolved by heat expands, and expanding it rises, and rising it would be followed by cold air settling down by the gulley gratings in the streets, thus constituting their inlets downcast shafts, and the sewers and drains themselves channels for the currents setting to the up-cast shafts, by which they would be relieved. The down draft into the sewers would carry with it much soot and fine dust, which would settle upon the liquid current and pass off with it, and so remove some of the tangible as well as the intangible impurities before referred to, from the air in our streets and about our houses.

Much in this way might be effected by the aid of causes in constant operation; but if the up-cast shaft to every house were also a fire-flue, or were only aided by the draft of a neighboring fire, the up-current would be sufficient not only to prevent the house drains from retaining foul air, but the foul air would be thrown off into the upper air with better effect, and be dissipated innocuously and without offence, instead of steaming as it now does from the sewers into the air where it cannot be avoided.

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*Description of Mr. Brunel's Bridge over the Wye.**

In the Exhibition is a model of a new kind of bridge, between a suspension and a tubular bridge, in the course of construction to span the river Wye, at Chepstow, invented by Mr. Brunel, the engineer of the South Wales railway.

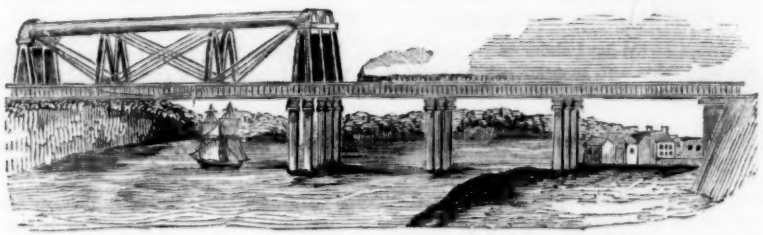
Every one knows what the Britannia bridge is across the Menai, at Bangor. It consists of two rectangular tubes, each of which has for the sake of strength, a sort of cellular or double top and bottom. The strongest and most essential part of this bridge is said to be the top. Mr. Brunel's Wye bridge is, as far as regards the roadways, two tubes without the tops. But to supply the tops he has, for each roadway, a hollow cylinder of iron suspended some distance above the roadway on piers. From the extremities of the cylinder on the piers, a chain loop runs under four pins on each side of the roadway for the purpose of helping to support it. Besides these loop chains there are two strong upright braces, one on each side, tying the iron cylinder to the outsides of the roadway, and from the top of each of these side braces to the bottom of the other another chain is drawn. Neither the utility nor the action of these brace chains have we been able to discover. But the loop chains are ingeniously contrived to give strength to the bridge with the least weight to the supporting cylinders. For by the loop chains coming from the points where the cylinders rest on their supports, if we suppose the tensile forces acting on each chain according to the rules of mechanics to be resolved into two, one pressing perpendicularly on the supports, the other must be in the direction of the cylinder, that is, endeavoring to compress it lengthwise, and therefore is in a direction which the cylinder is best able to sustain.

* From the London Railway Journal, No. 644.

With regard to the ties or braces before mentioned, and their diagonal chains, we have our doubts of their utility. They appear to us to be useless, while the braces or ties, should the bridge yield to the weight, will sink the middle of the cylinder with them, and consequently weaken it to sustain the opposite compressing forces of the loop chains at the extremities.

The span of the bridge is 290 feet; the height of the roadways 70 feet above high water mark. On the east or English side, the roadways rest on a rock, and on the Chepstow side on six upright iron cylinders, tapering, we believe, a little towards the bottom, and filled with concrete. Towards the west the roadways are continued, supported on cylinders filled with concrete, in the shape of a viaduct, for about 300 feet more, but without the sustaining cylinders. Each of the two roadways is independent of the other.

The *tout ensemble* of the bridge is light and elegant, as we judge from a model of it in the Exhibition. Externally it will have a much better effect than the tunnel tubes across the Menai, and will be more pleasant to the passengers from being open. Sailing up or down the Wye, the bridge will form a pretty addition to the picturesque scenery. It is now in the course of structure, and will probably not be completed for 12 months onwards. The total length of the bridge and viaduct is 623 feet; the clear water span for vessels 290 feet, with a headway of 70 feet at spring tides. The cylinders are 50 feet above the roadways. Beneath we give a drawing of the bridge as it will appear when finished, with the adjacent country.



AMERICAN PATENTS.

List of American Patents which issued from November 11, *to December* 2, 1851, *(inclusive,) with Exemplifications by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

21. For an *Improvement in Cheese, Butter, and Bread Cutters;* Benjamin F. Adams, Bangor, Maine, November 11.

Claim.—"What I claim as my invention is, the arrangement of the circular revolving table and knife; the said knife being attached to the sliding shaft, and operated by means of a treadle and weighted cord and pulley, or other equivalents, so that the cheese or other article to be cut may be placed upon the table, and not removed until, by a single revolution of the wheel, and a few slight pressures of the foot upon the treadle, it is cut into as many parts as may be desired, without crumbling or waste."

22. For an *Improvement in the construction of Scythe Fastenings;* David Anthony, Sr., Springfield, New York, November 11.

"The nature of my invention consists in attaching the scythe to the snath, in such a manner that the point may be thrown out or in, with the greatest possible facility."

Claim.—"Having thus described the nature of my invention and the manner in which it is constructed, what I claim as my invention is, the mode of adjusting the lever by rotating the ring around its own axis, by which the point of the scythe is thrown out or drawn in, as shown and described, the upper end of the lever passing through an eye attached to the ring, the fulcrum of the lever being near the end of the snath as shown, and the scythe attached to the lower end of the lever as set forth."

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23. For an *Improvement in Hand Planes;* Benjamin F. Bee, Harwick, Massachusetts, November 11.

Claim.—"What I claim as my invention is, the application to carpenter's planes and moulding tools, of a new method of confining the iron, by a metallic apparatus, acting upon the principles of the lever and cam, in combination with the set screw, for adjusting the same, as herein described; using for the purpose, the aforesaid contrivance, or arrangement of parts, or any other substantially the same, and which will produce the same effects in like manner."

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24. For an *Improvement in Screens for Winnowing Machines;* Jonathan Bean, Montville, Maine, November 11.

Claim.—"I do not claim any part or portion of the gear, fans, or forms of the hopper, or shoe, as an original invention, as I am aware that all these have been in common use; but what I do claim as new is, the arrangement of guides and side apertures in the upper movable screen, as seen in figure 3, and the lower screen, as seen in figure 4, attached to the shoe, and which screen may be attached to any common winnowing machine, in the manner and for the purposes before described."

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25. For an *Improvement in Stave-Jointing Machines;* Daniel Drawbaugh, White Hill P. O., Pennsylvania, November 11.

Claim.—"What I claim as my invention is, the adjustable knife, in combination with the adjustable rest, as described, to adapt them to the jointing of staves for casks of different bilge."

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26. For an *Improvement in Shuttle Motions of Looms;* George W. Perry, Thompson, Connecticut, November 11.

"My invention consists in hanging the picker staves, each on two radius rods, which are attached to fixed centres, on the swords, or frame of the lay, being connected by joint pins, one at the lower end and the other at a suitable distance from it. The effect produced by this arrangement being to cause the end of the staff, which acts upon the shuttle, to move in a right line, parallel to the raceway—the two radius rods producing a parallel motion, without the aid of any other device for guiding or controlling it."

Claim.—"Having thus described my invention, I do not claim hanging the picker staff on a radius rod, as I am aware that it has been so hung, and by the aid of other devices, in connexion, a motion parallel to the raceway has been produced; but what I do claim is, hanging the picker staff, or staves, upon radius rods, having two distinct radial motions, substantially as herein set forth, for the purpose of causing the end which operates upon the shuttle to describe or make a rectilinear motion, parallel with the raceway, and with less power than has heretofore been done."

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27. For an *Improvement in Machines for Cutting the Soles of Boots and Shoes;* Joseph Steger, Roxbury, assignor to William Mitchell, Boston, Massachusetts, November 11.

Claim.—"Having thus described my improvements, I shall state my claim as follows: What I claim as my invention is, the mode or means herein above described, for insuring

the unerring turning of the knife frame, for cutting both sides of the sole; said means consisting of the notched pawl lever and spring, *y*, *y*, operating on the journal plates of said frame, substantially as herein above described."

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28. For an *Improvement in Car Seats;* Ezekiel Booth and Ezra Ripley, Troy, New York, November 11.

Claim.—"Having thus described the nature of our invention, what we claim as new is, the arrangement of two levers, in a cross position, so that any required height of back may be carried and reversed, from and to either side of the seat, and secure it firmly in its position, at any required angle, substantially the same as described and represented."

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29. For an *Improvement in Telescopes;* Alvan Clark, Cambridge, Massachusetts, November 11.

Claim.—"What I claim as my invention or improvement consists in combining the glasses, or glasses and diaphragms, with a sliding or eye piece tube A of a telescope, by means of a tube or slide B, perforated through its side, or sides, in such manner as to enable a person, when the said tube B, is withdrawn from its enclosing tube, to obtain ready access through the openings or perforations, to the glasses or lenses; the whole being substantially in the manner and for the purposes as described."

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30. For an *Improvement in Machines for Cutting Hides;* Jacob C. Flint, Boston, Massachusetts, November 11.

Claim.—"What I claim as my invention is, the combination of mechanism for reducing dry hide to a strip, and mechanism for cutting or removing the hair from the underside of the said strip at one continued operation, substantially in the manner as described."

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31. For an *Improvement in Bending Felloes;* Andrew W. Johnson, St. Georges, Deleware, November 11.

Claim.—"Having thus described the nature and operation of my invention, what I claim is, the curbs C D, in combination with the box B, or its equivalent; said curbs being constructed in the manner and for the purpose substantially as described."

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32. For an *Improvement in Card Grinders;* Richard Kitson, Lowell, Massachusetts, November 11.

Claim.—"What I claim is, an instrument for grinding or sharpening wool, cotton, or other cards, made with sectorial card teeth, which are so bent at the heel, as to make the sharp edge more prominent than its opposite and broad edge, together with its application to the card that is to be ground, in such a direction as to cause the sharp edge of the teeth of the grinder to be first presented to, and enter among the teeth of the card."

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33. For an *Improvement in Daguerreotype Apparatus;* Wm. Lewis, Wm. H. Lewis, and J. Lewis, City of New York, November 11.

Claim.—"We claim, 1st, The construction of a camera box, with a cross opening, or mortise, to receive a sliding frame, that carries both an object glass and the daguerreotype plate, as described.

"2d, The construction and application of a sliding frame with a division to receive a frame carrying an oblong object glass, so formed as to be placed either vertically or horizontally, as described and shown.

"3d, The construction of the slide, so as to receive, in the other division, a daguerreotype plate in a frame, such frame being pressed in place by springs, and held in place by blocks taking notches in the frame, as described and shown."

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34. For an *Improvement in Coupling Railroad Cars;* Lorenzo D. Livermore, Hartland, Vermont, November 11.

Claim.—"What I claim as my invention is, the combination of a stiff car coupling

with the ends of a couple of cars, and with the trucks under the same, substantially in the manner herein set forth, by which the cars are made to guide the trucks under them, and keep them in their proper positions on the track, to wit: in such positions, that a line drawn midway between and parallel with the truck axles, will be at right angles to any straight track, and also at right angles to the tangent of any curved railroad track."

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35. For an *Improvement in Abdominal Supporters;* Allen J. Lonsbury, Somerville, Tennessee, November 11.

"The principal feature of this invention, and upon which its utility and excellence mainly depends, consists in the peculiar form of the front plate or pubic brace, and its peculiar connexions with other parts of the apparatus."

Claim.—"What I claim as my invention is, the employment of a pubic brace of the peculiar form herein described, and as represented in figures 2, 3, 4, 5, 6 and 7, of the drawings, so as to fit the os pubis, and press uniformly upon the inguinal region, while the upper edge of the brace is bent forward, so as to effect no inconvenient pressure upon the abdomen of the wearer; said pubic brace being made of hammered leather or other tenacious material, in the manner and for the purpose herein described."

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36. For an *Improvement in Bedsteads;* Levi Newcomb, Jr., New Bedford, Massachusetts, November 11.

Claim.—"Having thus described the nature of my invention, and the manner in which it is constructed, what I claim as new is, the manner of securing the lower bedstead to the upper one, so that it may slide underneath the upper one, or drawn out from it, as described, viz: by having the clamps attached to the upper part of the foot posts of the lower bedstead, and clamps fitting in the recesses of the rails of the upper bedstead, and the rails of the lower bedstead passing through the mortise holes in the foot posts of the upper bedstead, substantially as shown and set forth."

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37. For an *Improvement in Horse Collars;* Richard Rickey, Rutland, Ohio, November 11.

"The nature of my improvement consists, principally, in having two metallic plates, connected by a joint, so as to open and close with ease, and to be secured by two levers which are attached to their upper ends, and connected by a strap; these plates constitute the frame, or body of the two pads which press on the lower part of the shoulder, but do not reach up to the shoulder blade."

Claim.—"What I claim as my invention is, connecting the sides of the breast plate by a flat joint, in combination with the levers attached to the sides of the breast plate, and rising over the neck without touching the shoulders of the animal, and connected at the top, by which means the breast plate is made adjustable to the size of the horse, substantially as herein set forth."

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38. For an *Improvement in Grain Kilns;* Isaac S. Stover, Erwinna, Pennsylvania, November 11.

Claim.—"What I claim as my invention is, the combination of the heating chamber, with the two drying beds, one above and the other below, as described."

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39. For an *Improvement in Frosting Plates of Glass;* Isaac Taylor, City of New York, November 11.

Claim.—"What I claim as my invention is, the use of a rocker containing pebbles, sand, and water, for the purpose of frosting plates of glass, or embossed work, as above described."

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40. For an *Improvement in Boot Trees;* Davis R. Hendrix, Pottstown, Pennsylvania, October 28.

"The nature of my invention consists in stretching boots or shoes, by regulating the set screws in the foot."

Claim.—"What I claim as my invention is, the set screws *m* and *n*, and plate *x*, in

combination with the screw *g*, substantially in the manner and for the purpose herein described and set forth."

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41. For an *Improvement in Apparatus for Sizing and Dyeing Yarns;* Alonzo Bascom, East Jaffrey, New Hampshire, November 18.

Claim.—"Having thus described my improvements, I shall state my claims as follows: What I claim as my invention is, 1st, the conducting of yarn or thread, from section or warper beams, directly into and through the size or coloring liquids, to the pressure rollers, by a series of rollers, more or less in number, placed as nearly in contact with each other as the nature of the case will admit, the closer the better, sufficient space being allowed between the fixed rollers for the passage of the yarns or threads, thus enabling the said rollers to operate as guides to each and all the threads, to prevent them from matting or clinging together, and superseding the otherwise necessary use of reeds, raddles, or other separators.

"2d, I claim the taking or making of a weaver's lease, or series of leases, at the commencement of the process of warping or beaming of yarn or thread, on section or warper beams, and at proper intervals on the same, to correspond with required lengths of yarns, or threads, on weaving beams, and preserving the same throughout the sizing and drying; thus dispensing with the use of hacks, or lease takers, in the dresser, and the otherwise necessary stoppage of the dresser or sizer, for the purpose of tying or twisting together each separate thread."

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42. For *Improvements in Printing Presses;* Thomas H. Dodge, Nashua, New Hampshire, November 18.

"The nature of my invention consists in hanging the platens and type beds of printing presses on cranks, on parallel shafts, which are so arranged that the platens and type beds are always parallel, or nearly parallel to each other, during the revolutions of the shafts."

Claim.—"Having thus fully described the nature, construction, and operation of my invention, I will proceed to state what I claim.

"1st, Hanging the type bed and platen upon cranks on rotating shafts, arranged and operating in the manner substantially as herein described.

"2d, The spring presser attached to the type bed, or platen, for the purpose of pressing the band *e*, communicating motion to the sheet, against the opposite surface of the platen or bed, and causing it to be moved at precisely the same speed as the bed and platen, substantially as described.

"3d, The arrangement for carrying and giving motion to the inking roller, consisting of the barrel P, the bars Q and *p*, the lever R, springs *r* and *t*, and band *u*, combined together and with the above type bed and platen, in the manner substantially as set forth."

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43. For an *Improvement in Machines for Cutting Combs;* S. Curtis, Newtown, Connecticut, November 18.

Claim.—"Having thus described the nature and operation of my invention, what I claim as new is, the wheel B, with the cutters *t*, placed on its periphery, as described; said wheel having a rotary motion, and also a vertical reciprocating motion, in a transverse line with its axis, for the purpose of turning or cutting comb teeth, substantially as described; said motion being given the wheel by means of the cams, levers, and pawls, or their equivalents, as set forth."

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44. For an *Improvement in Stove Grate Bars;* George W. Gardner, Albany, New York, November 18.

Claim.—"What I claim as new is, the manner described, of forming separate grate bars for vibrating grates, rounded at their ends, secured and working in grooves of the frame, as described."

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45. For an *Improvement in Ploughs;* Henry Goldson, Greensborough, Mississippi, November 18.

"My invention consists of an implement, by means of which the surface of the earth

lying near to the cotton plants and the weeds growing therein, can be pared off in a thin slice, without injury to the roots of the plants, and thrown towards the centre of the open space between the rows."

Claim.—"What I claim as my invention is, a cotton scraper constructed as herein described, with a share and mould board, projecting from the side of the landside, opposite that to which the earth is thrown; the landside thus extending from the point of the scraper to that wing of the mould board opposite the one to which it usually extends, and the several parts being so arranged, that the landside will run deep enough to hold the implement firmly to its work, the share will pare the ground and cut off the weeds near the roots of the plants, and the mould board will conduct the same towards the middle of the space between the rows."

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46. For an *Improvement in Propellers for Machinery to be Used in Currents;* James Hardie, Victoria, Texas, November 18.

Claim.—"I do not confine myself to the exact mode of gearing herein described, as many modifications of the same may be used, and answer equally well; but what I claim as my invention is, the application for the purpose specified, of one or more levers with the floats or blades at their lower ends, against which the current acts, said levers being attached at about their centres to an adjustable frame by an universal joint as described, the upper ends of the levers being attached to cranks, by which, through any suitable gearing, motion is communicated to the shaft substantially as described."

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47. For an *Improvement in Railroad Car Wheels;* Nehemiah Hodge, Adams, Massachusetts, November 18.

"My invention consists in making a car wheel in not less than two concentric parts, and connecting these parts by vulcanized india rubber or other analogous elastic material interposed between them, whereby the annular or outer part of the wheel is insulated from the central or inner part, by a substance that will not transmit vibrations from the rim to the centre or axle of the wheel, whether such vibrations be lateral or radial in direction."

Claim.—"What I claim as my invention is, connecting the tread or rim of a car wheel to the hub or central part thereof, by means of india rubber or other analogous elastic material, such elastic material being connected with the outer periphery of the central part of the wheel by a groove on the latter or its equivalent, and to the inner periphery of the rim also by a groove thereon, or its equivalent; the india rubber holding itself in both grooves by its elasticity, and giving to the wheel lateral as well as radial elasticity, as herein described.

"I also claim the grooved segments, constructed substantially as herein described, and interposed between the india rubber and the rim, for the purpose of facilitating the insertion of the india rubber into the space between the rim and central part of the wheel, and its removal therefrom, as herein set forth."

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48. For *Improvements in Mill for Grinding and Bolting;* Jehu Hollingsworth, Zanesville, Ohio, November 18.

Claim.—"Having first fully described the nature of my invention, what I claim therein as new is, 1st, the grinding of grain or other material by means of a revolving stone or metallic roller, and one, two, or more separately adjustable concaves, whereby "*high* and *low*" grinding may be performed simultaneously, and bolting the same the instant that any particles are ground fine enough, in combination with the returning on to the roller again, all particles too coarse to be bolted through the bolting concave, so that they may be ground over again and again, until they are fine enough to be discharged; and this I claim, whether it is done by means of the revolving beaters and brushes which throw it up and through the pipe, or by any other means essentially the same.

"2d, I claim the guide or partitions in the pipe as herein described, to prevent meal from scattering endwise in its transit from the bolting concave to the roller, in combination with the adjustable aprons on which it falls, and which distributes and governs it in its passage to the discharging end, as herein described and set forth."

49. For an *Improvement in Cannon for Throwing Chain Shot;* Adam Lemmer, Newark, New Jersey, November 18.

Claim.—"What I claim as new is, in combination with the revolving head, and the bores diverging as described, the rack attached to the gun, and the worm wheel hung on the shaft, by which the gun is made to revolve or turn to the desired position, so that the chain shot may be thrown either in a horizontal or vertical line."

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50. For an *Improved Screw Propeller;* Gaspard Malo, Dunkirk, France, November 18.

"My invention consists in the employment for propelling vessels of a screw, composed of two or more series of movable vanes or wings; each series attached to a separate shaft, and the shafts placed one within the other, and provided with keys, or other equivalent means of connecting and disconnecting, so that the shafts can be turned on each other, for the purpose of placing the two or more series of vanes behind each other for sailing purposes, or at different parts of the circle, to increase the paddle surface when used for propelling."

Claim.—"And having now described the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim as my invention, is arranging two or more series of narrow blades, such as above described; each series on a separate shaft, and the shafts one within the other, and provided with keys or other equivalent means of securing them to each other, substantially as specified, so that the two or more shafts may be turned on each other, and resecured to place the series of vanes directly behind each other for sailing purposes, and at different points of the circle for propelling."

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51. For an *Improvement in Desks;* Isaac H. Norris and David Flanders, Parishville, New York, November 18.

"The nature of our invention consists in constructing the top of the desk in two parts or pieces, each of which, situated side by side, is lowered and raised at pleasure by appropriate mechanical devices therefor, so that a proper level is easily obtained for either side of the book; and further, in the employment of a jointed leaf or leaves in the front of the desk, which when bent down or in, admit of the book being brought forward, and when raised up or out, form a rest for the hand."

Claim.—"What we claim as our invention is, 1st, forming the desk top in boxes, parts, or pieces, each of which may be separately raised or lowered, as required, through appropriate mechanical devices, substantially in the manner and for the purposes shown and set forth.

"2d, The employment of hinged double leaves in the front of the desk, the same when extended forming a rest for the hand, and being made capable of closing down or in, essentially as described."

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52. For *Improvements in Railroad Switch;* David F. Phillips, Republic, Ohio, November 18.

Claim.—"Having thus described my invention and improvements in the self-adjusting and locking switch for railroads, I wish it to be understood that I am aware that the relative position of the switch with the main track, or turnout, or sideling track, has been changed by the action of mechanism attached to the cars, as well as by devices attached to the locomotive in various ways; and therefore, I do not claim changing the switch by apparatus or devices actuated by the cars or locomotive; nor do I claim constructing and operating a switch, composed of a single movable section of the main rail: but what I do claim as my invention and improvement is, the employment of the additional movable sections in combination with the sections forming the switch, whereby the lateral movement of each is halved or divided in opposite directions, and a more regular curve is produced than that resulting from the use of the single movable section or switch, and thereby insuring safety, the weight of the train of cars on one section of the switch, forming a lock to the other section, as one section cannot move without the other till the train of cars shall have passed therefrom, as herein fully set forth. I also claim the combination of the double central lever bars, with the central connecting rock shaft, having two cranks projecting in opposite directions, to which are attached the cross bars for uniting the

double sections, whereby the switch is adjusted, as fully set forth and shown in the drawings."

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53. For an *Improvement in Seed Planters;* William Redick, Uniontown, Pennsylvania, November 18.

Claim.—"Having thus fully described my invention, what I claim therein as new is, the combination of the slides *f g*, with the grooves *a*, (which "drill in" the grain,) and the cells *c e*, so that by moving the slats *f* towards the centre of the hopper, to close the communication with the grooves and open it with the cells *c*, for planting in "check rows;" or by moving both the slats *f g* towards the centre of the hopper, to close the communication between said hopper and the grooves *a* and cells *c*, and open it with the cells *e*, for planting in "step-rows;" the whole being arranged in the manner and for the purpose herein set forth and fully shown."

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54. For an *Improvement in Inserting Porcelain Teeth;* William Willshire Riley, Columbus, Ohio, November 18.

Claim.—"What I claim as my invention is, the mode of inserting teeth, by forming the concave base, and of inserting the platina pins into the base of the platina surface of the teeth in an oblique direction, and attaching them to the gum plate without stays."

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55. For an *Improvement in Stoves;* Hale R. Rose, Guilford, Vermont November, 18.

Claim.—"What I claim as my invention is, placing the damper between the fire and hot air flues, so as to control the amount of opening in each respectively, and governing the same by the expansion of the rod substantially as herein described, for the purpose of regulating the heat of the oven. I do not claim the expanding rod irrespective of its connexion with the damper, placed as described."

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56. For an *Improvement in Stove Grates;* H. J. Ruggles, West Poultney, Vermont, November 18.

Claim.—"Having thus fully described my new and improved fire chamber for stoves, &c., what I claim therein as new is, the inclined elevater for raising the back grate and coupling it with the front grate; and in combination, the connecting the front and back grates with hooks or catches, constructed and arranged substantially as above specified."

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57. For an *Improvement in Spring Saddles;* John C. fr. Salomon, Cincinnati, Ohio, November 18.

"The nature of my invention consists in making a saddle tree with a movable pommel and cantle, which are connected with the pads by link joints, and with each other by a spiral spring or springs, and a raw hide covering, forming the seat."

Claim.—"What I claim as my invention is, the movable pommel, the spiral spring or springs connecting the pommel and cantle, and the raw hide seat, all combined substantially in the manner herein set forth, making a spring seat saddle tree."

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58. For an *Improvement in Gongs;* Vine B. Starr, East Hampton, Connecticut, November 18.

"The nature of my invention consists in constructing gongs of sheet or plate iron, or steel, with a rim all round, strengthened by a ring or band, the whole being coated, having the crevices, interstices, and all unsound parts filled with a suitable alloy, say of copper and tin, for producing the desired sound or ringing tone."

Claim.—"What I claim as my invention is, making gongs of sheet or plate iron, or steel, with a rim all round, strengthened by a ring or band, the whole being coated, and having the crevices, interstices, and all unsound parts filled with an alloy of copper and tin, or any alloy of a similar nature, or compound of similar metals to what is usually called "bell metal," substantially as herein set forth."

59. For an *Improvement in Finishing and Balancing Millstones;* George Todd, St. Louis, Missouri, November 18.

Claim.—"What I claim as my invention is, the inserting the balance rine in the eye of a millstone, in the early stage of its construction, and then making use of the said balance rine, in conjunction with a chuck combined with the spindle, in completing the stone, substantially as herein set forth."

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60. For an *Improvement in Wires for Making Pile in Woven Fabrics;* Erastus B. Bigelow, Clinton, Massachusetts, November 25.

"The nature of my invention consists in combining with the flat pile, or figuring wire, employed in the weaving of looped or piled fabrics, and attached to one end thereof, a weight projecting from the lower edge, so that when such wires are deposited in the open shed of the warps, and during the operation of beating up with the lay, the preponderance of the said weight will retain the wire in the proper position."

Claim.—"I do not limit myself to any particular form or mode of attaching the weight, as this may be variously modified. What I claim as my invention is, combining with the flat pile, or figuring wire, employed in weaving looped or piled fabrics, and attached to or near one end thereof, a weight, for the purpose and in the manner substantially as described."

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61. For an *Improvement in Fastenings for Garments;* Elias Howe, Jr., Cambridge, Massachusetts, November 25.

"My invention consists of a series of clasps, united by a connecting cord, the said clasps running or sliding upon ribs formed of any suitable material."

Claim.—"Having thus described my improved mode of fastening garments, &c., I shall state my claim, as follows: What I claim as my invention is, the opening, closing, and fastening together, the two sides of a garment, or other article, by means of the clasps and ribs, operating in combination, substantially in the manner herein above described. I also claim the method of connecting the clasps, one to the other, in pairs, and in the series of pairs, by the links, cord and beads, substantially in the manner herein above set forth."

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62. For an *Improvement in Cooking Stoves;* Hosea H. Huntley, Cincinnati, Ohio, November 25.

Claim.—"Having thus fully, clearly, and exactly described and represented my improvements in stoves, what I claim therein as new are, the diving flues opening from the floor, as described, and in combination with this, the chamber for the purpose described."

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63. For an *Improvement in Cooking Stoves,* George W. Carleton, Brunswick, Maine, November 25.

"The nature of my invention consists in constructing a stove in such a manner, that it may be changed by adjusting some of its parts into an air-tight, or draft, wood, or coal cooking stove, cooking range, or a wood or coal draft, or air-tight radiating stove, or into a Franklin stove for wood or coal."

Claim.—"What I claim as my invention is, the employment of the three movable plates, C, D, E, constructed and arranged as described, viz: the plate E, being hollowed, affording a passage or flue, when not cut off by the damper, through which the heat passes, warming the ovens formed by the plates, the plates being capable of being withdrawn from the stove, or varied in a vertical position; by which arrangement the stove can be converted into an air-tight, or draft, wood, or coal cooking stove, cooking range, or a wood or coal draft, or air-tight radiating stove, or into a Franklin stove, substantially as set forth."

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64. For an *Improved Safety Apparatus for Steam Boilers;* Jonathan and John I. G. Collins, Chester, Pennsylvania, November 25.

Claim.—"First, we claim as our invention, the bent tube formed and arranged substantially as described, to contain mercury, in combination with the lever of the safety

valve, or its equivalent, and connected with the steam boiler by means of a swivel and a pillar connexion, or its equivalent, whereby the varying pressure of steam varies the actual weight upon the valve.

"2d, We also claim the combination of the connecting rod Q, and the lever O, I, and the shaft R, for connecting the mercurial gauge T, T and U, with the catch box N, and projecture O, on the catch box, whereby the mercury in the gauge T, T, being the weight, holds down the safety valve, or sets it at liberty, by the pressure of steam from the pillar E, and swivel S, S, said pillar being supplied with steam from the boiler or boilers, as described in the specifications.

"3d, We also claim the combination of the rod M, with the spiral spring upon it, and small pulley at the top of it, with the notched pulley L, for holding the catch box together, so long as the full part of the pulley L, is on the small pulley, or setting it at liberty, when that part of the pulley that is cut out comes opposite the small pulley, and thereby allowing it to ascend, as described in the specification."

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65. For an *Improvement in Ploughs;* Elijah Goldthait, Fort Wayne, Indiana, November 25.

Claim.—"What I claim as my invention is, first, the cutter C^4, or its equivalent, to separate the sward for the first furrow at a proper distance from the coulter, acted upon by the prop a^3, and lever C^5, or their equivalents.

"2d, Is the piece D^3, fastened to the heel of the mould-board, in combination with the cutter C^4, to turn wide furrows.

"3d, Is the mode of connecting the tongue and plough, respectively, to the axle, by means of the links and the loose tenon on the tongue, substantially as described, so as to allow the team to walk entirely aside from the furrow, or direct course of the plough, in ploughing prairie, marsh, or other land, with soft under strata, and make the plough run smoothly and work well; and so as also to enable the ploughman to take an extraordinarily wide furrow, with one member of the team walking in the furrow, with a common yoke, thus dispensing with the long yoke now commonly used for that purpose.

"4th, Is the rope D, and lever D^1, or their equivalents, in combination with the mode of connecting the tongue and plough to the axle, substantially as described, for the purposes set forth in the within specification."

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66. For an *Improvement in Centrifugal Sugar Drainers;* Daniel King, Brooklyn, New York, November 25.

Claim.—"What I claim is, centrifugal machines for separating fluid from other matter, constructed and operating as herein set forth, with detachable vessels containing the substance to be operated upon, irrespective of the exact mode of attachment, the number of vessels used, or their form."

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67. For an *Improved Method of Operating Rudders;* Thomas H. Mortimer and James Gardiner, Charleston, South Carolina, November 25; patented in France, June 11, 1851.

"This invention consists in certain means to be employed in vessels steered by two rudders, one on each of the stern post, for the purpose of controlling the said rudders and bringing either one into operation, while the other is stationary."

Claim.—"Having thus fully described our invention, we will proceed to state what we claim as new: We claim controlling the operation of the rudders, in such a manner as to bring either into operation while the other is stationary, by means of the pins, or studs, on their tillers, in combination with the grooves or slots, in a wheel or disk, receiving motion upon an axis, or by the equivalents of the same, substantially as herein described."

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68. For an *Improvement in the Manufacture of Door Knobs;* Orrin Newton, Pittsburgh, Pennsylvania, November 25.

Claim.—"I claim the combination and arrangement of the arms, sliding plate, springs, and lever, substantially as described, operating in the manner, or in any analogous way, for the purpose set forth."

69. For an *Improvement in Drop Presses;* Milo Peck, New Haven, Connecticut, November 25.

Claim.—"What I do claim as my invention is, the general arrangement and combination of the crank and shaft with its sweeps, moving in the same direction with the moving gear or pulley, and the ratchet wheel joined together, and running loose upon the shaft constantly in the same direction, substantially as I combine them, for the purposes herein described. I also claim the lock, in combination with its sweep and springs, and with the crank, to stop its motion not too abruptly, and to hold it until it is unlocked, by the hand or foot of the workman, substantially as described."

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70. For an *Improvement in Cider Mills;* David F. Phillips, Republic, Ohio, November 25.

Claim.—"Having thus described the portable cider-mill, I wish it to be understood, that I make no claim to originality of invention to any part of the mill, separately considered; nor do I claim as new, any part of the arrangement of the press, grinding cylinder, or hopper. But what I do claim as new is, first, the arrangement of the parallel slicing knives, in combination with the reciprocating follower, made as described, with channels and ribs on its inclined face, when used with a grinding cylinder, and concave, made and arranged as described and represented, for first slicing the apples, and then delivering the slices, successively, to the grinding cylinder, to be reduced to pumice, in the manner herein described."

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71. For an *Improvement in Shingle Machines;* Franklin Skinner, Dunkirk, New York, November 25.

"The nature of this invention consists in constructing a shingle riving and shaving machine, with such devices and peculiarities, that it may rive shingles of any required thickness, even from timber whose grain is crooked or irregular; and that will shave shingles on both sides at one motion, accurately preserving the longitudinal centres thereof, even when the grain of the timber is winding; and that will, moreover, shave shingles of a uniform thickness for a part of the length thereof, according to the option of the operator, and wedge-shaped, or tapering, for the rest of the length thereof."

Claim.—"What I claim as my invention, are, first, the peculiar form and mode of adjusting of the riving plate E, the same being self-adjusting, by means of the spring F, upon which it rests, and the end of the plate contiguous to the riving knife, being bent upward, (to accommodate irregularities in the grain of the shingle timber,) as herein specified.

"2d, The employment (in combination with a shingle shaving machine) of the rolls T, levers x, z, hanging rods X, spring k, and bent lever p, or their equivalents; the whole being arranged and operated in the manner and for the purpose herein described; the levers, rod and spring acting upon the rolls, and pressing them uniformly towards each other, for the purpose of unwinding or straightening the rived shingle, in the first instance, and the bent lever, (being operated by the motion of the connecting rod R, and acting upon the spring k,) having the effect of increasing the force or pressure of the rolls upon the shingle, (as the latter passes between them,) for the purpose of preventing the splitting of the shingle, in advance of the cutters, as they approach the thin end of the shingle, as herein set forth."

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72. For an *Improved Valve for Oscillating Engines;* Wm. M. Smith, Georgetown, District of Columbia, November 25.

Claim.—"I do not claim the circular valve, nor the manner of reversing the engine by turning the valve. But what I claim as my invention is, the arrangement of the piston valve with a ground face, in a cylindrical steam chest, as described above, by which the necessity of packing about the trunnion and plummer block is avoided, consequently saving much friction in the trunnion."

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73. For an *Improvement in Railroad Car Brakes;* Francis A. Stevens, Burlington, Vermont, November 25.

Claim.—"What I claim as my invention is, the combination and arrangement of the

levers, link-rods, and shoes, or rubbers, substantially as herein described, whereby each wheel of both trucks of a car is retarded with an uniform force, when the brake is put into operation."

RE-ISSUES FOR NOVEMBER, 1851.

1. For *Improvements in the Screw Wrench;* Solyman Merrick, Springfield, Massachusetts; patented August 17, 1835; re-issued November 25, 1851.

Claim.—"What I claim as my invention is, combining with a wrench, in which the inner jaw slides on a bar permanently attached to the outer jaw, and making part of, or permanently attached to the handle, substantially as described, a screw thread and nut connecting the movable jaw with the said bar, between the said movable jaw and that part of the handle grasped by the operator, in the manner and for the purpose, substantially as described. I also claim the arrangement of the screw upon the two circular edges of the flat bar, in the manner and for the purpose herein described."

DESIGNS FOR NOVEMBER, 1851.

1. For a *Design for Stoves;* J. W. Gibbs, Albany, New York, Assignor to North, Harrison & Chase, Philadelphia, Pennsylvania, November 11.

Claim.—"What I claim as my invention is, the ornamental design for a stove, as herein described, and as represented in the annexed drawings."

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2. For a *Design for Iron Railings;* Frederick Fitzgerald, Assignor to Silas C. Herring and John Ryer, City of New York, November 18.

Claim.—"What I claim as my invention is, the design, arrangement, and configuration of the several ornaments composing the balustrade and step railing, branching or leading therefrom, as represented and described."

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3. For a *Design for Parlor Stove Plates;* Apollos Richmond, Assignor to A. C. Barstow & Co., Providence, Rhode Island, November 18.

Claim.—"What I claim as my production is, the new design, consisting of the mouldings, panels, and ornamental configurations, herein above described and represented in the drawings, respectively for the top, front, and end plates of a parlor stove."

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4. For a *Design for a Hat Stand;* Charles Muller, Tompkinsville, New York, November 18.

Claim.—"What I claim as my invention is, the design and configuration of a hat stand, representing a Triton, or similar figure, holding up the branches of a plant, in the manner aforesaid, with the basin lying in a bed of leaves or flowers, all arranged substantially as above described and set forth."

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5. For a *Design for a Parlor Stove;* Ezra Ripley and N. S. Vedder, Assignors to Low & Hicks, Troy, New York, November 25.

Claim.—"What we claim is, the design and configuration of a parlor stove, substantially the same as herein described and represented in the annexed drawing."

DECEMBER.

1. For *Improvements in Looms for Weaving Bags;* Cyrus Baldwin, Manchester, New Hampshire, December 2; ante-dated August 30, 1851.

Claim.—"What I claim as my invention is, first, placing the cams upon one or more shafts, in such a manner that they can be moved, so as to change their relative position in regard to each other, with or around the shaft, if upon separate shafts, or around the shaft, if upon the same shaft, in combination with the devices, substantially such as

are herein described, or their equivalents, for releasing, changing, and holding said cams, as may be required, for the purposes set forth in the foregoing specification.

"2d, Is the pin v, on the spring f^1, in combination with the pawl, m, or their equivalents, to force back the rod d^3, and propel the wheel I, by the pin d^2, acting against the inclined sides of the notches h^2, h^3, so that the pin d^2 will fall back on the groove d^1, and allow the wheel I, to be propelled by the pin c^4."

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2. For an *Improved Hand Drill;* Wm. Bushnell, City of New York, December 2.

Claim.—"What I claim as my invention is, the combination of the helical spring with the screw upon the drill shaft, and the opening and closing nut or screw nippers, the whole being applied in the manner substantially as described, and operating for the purpose of controlling all the required movements of the drill, in the line of the axis of its revolution, in giving it the pressure upon its work, controlling the said pressure, and withdrawing it from its work, as herein fully set forth."

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3. For *Improvements in Hurdle Fences;* Cyrus C. Cole, Rushville, New York, December 2.

Claim.—"Having thus fully described my improved fence, what I claim therein is, the method of locking and supporting the same, by means of the notched sills and lock braces, as herein described."

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4. For an *Improvement in Machines for Crimping Package Papers for Soda Powders, &c.;* Carlos A. Cook, Lowell, Massachusetts, December 2.

Claim.—"What I claim as my invention is, the combination and arrangement of the surfaces, t, u, v, w, x, p, b, a, c, d, in the manner substantially as represented in the drawings, and for the purpose of folding the paper in a trough-like shape, and in other respects convenient for being filled with powder, and folded together."

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5. For an *Improvement in Railroad Switches;* William N. Raines, Thomson, Georgia, December 2.

Claim.—"Having thus described my invention and improvement, and pointed out the difference between the same and other railroad switches, what I claim therein as new is, 1st, the combination of the stationary single casting c, with the single casting or switch g, each having a guard on the inside thereof, whereby the said permanent single stationary casting c, is made to subserve the purpose of the ordinary frog and auxiliary switch, in connexion with the turn-out side of the main track, as described.

"2d, I also claim, providing the movable casting g, on the inside thereof, with a guard m, for the purpose of guiding the train of cars over the switch, in a straight line, when running in the direction of the arrow y^3, and thus prevent the cars from passing on to the turn-out rails, when the switch is in the position shown in fig. 2; the projection, or frog f, being of sufficient length, in connexion with guard m, to guide the train on to the main rail a, as described."

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6. For an *Apparatus for Propelling and Steering;* John C. fr. Salomon, Cincinnati, Ohio, December 2.

"The nature of my invention consists in forming water-ways in the rudder, and appending thereto a submerged water wheel and propelling wheel, or wheels, to be worked by a force of water through said water-ways."

Claim.—"I do not claim the peculiar wheel here used, as a water wheel and propeller; but what I claim as my invention is, the combination of the water-ways in the rudder, with a water wheel and submerged propeller, to be operated by hydraulic pressure, for propelling and steering vessels, substantially as herein set forth."

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7. For an *Improved Lock for Safes, &c.;* F. C. Goffin, Assignor to Charles J. Gayler, City of New York, December 2.

"My invention consists in arranging and combining a 'talon' with a series of tumblers,

said talon having a stud upon it, and so arranged that when the stud is within a curved slot in the tumblers, the key may act upon the talon and bolt; but when the stud is thrown out of the curved slot, and above the outer surfaces of the tumblers, the key cannot act upon the bolt; the stud therefore must be brought within the curved slots, before the bolt can be withdrawn or acted upon by the key: this arrangement effectually prevents the lock from being picked."

Claim.—"I do not claim the knobs D, D, and collars E, E, with the numbers on them, for the purpose of serving as indexes, as they have been previously used; neither do I claim a series of tumblers, as those described, for these have also been previously used. But what I do claim as new is, the 'talon' N, with the stud *q*, attached to it, in combination with a series of tumblers O, having curved slots *o*, in them; said talon and tumblers operating as described, viz: the talon being thrown up by the key, during the second revolution, and the stud *q*, in consequence, placed on the other side of the tumblers, the talon being held up by the catch P, the catch *y*, on the talon, bearing against the stump *z*, and preventing the bolt from being moved back or withdrawn; the talon N, requiring to be let down when the bolt is to be withdrawn, so that the stud *q*, may work or slide in the curved slot *o*, in the tumblers, and catch *y*, be free from the stump *z*, the bit of the key, in turning, acting upon the end of the talon and shooting back the bolt, substantially as described."

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8. For *Improvements in Railroad Car Trucks;* Benjamin Hinkley, Troy, New York, December 2.

Claim.—"Having thus fully described my invention, what I claim therein as new is, hanging the frame of a six-wheel truck immediately on the centres of the front and rear axles by a shank and socket, and to the centre axle by guides, in combination with horizontal diagonal or other bracing, connecting and operating said wheels, so that they may adjust themselves to any lateral curvature in the track, and at the same time allow either of the sets of wheels to pass over any obstruction, without raising the other sets from the track; and for the purpose, also, of allowing the set from which the weight is removed, to still retain its position on the track, for guiding the others, as herein fully set forth and described."

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9. For an *Improvement in Steam Carriages for Railways;* Joseph H. Moore and William P. Parrott, Boston, Massachusetts, December 2.

Claim.—"Now we wish it distinctly understood, that we do not claim the combination of a steam engine with the axles or body of a carriage; nor do we claim any arrangement of it, by which it is directly applied to a 'fixed' axle, or one so connected directly with the carriage body, that other than a rotary motion, it can have no horizontal and rocking movements independently of the same. But what we do claim as our invention or improvement is, the arrangement or arranging the steam engine directly on a *movable* truck frame of a 'long car' or carriage, in combination with arranging the boiler, or steam generator, on or in the carriage body or frame, and connecting the engine and steam generator by a flexible pipe, or pipe having a ball and socket, or other equivalent connexion or joint, such as will allow of all the necessary rotary and rocking movements of the truck frame and carriage body; the whole being substantially as herein before described."

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10. For an *Improvement in Expanding Mandrels;* Walter Sherrod, Providence, Rhode Island, December 2.

"The nature of my invention consists in the use of an arbor, having a taper screw cut upon it, on which is fitted an expanding shell, or nut, formed of segments or pieces, whose length lie longitudinally with the arbor, and which are held together by coiled springs encircling them."

Claim.—"What I claim as my invention is, 1st, the use of an expanding nut or shell, formed in segments, whose interior faces have portions of a screw thread cut thereon, which fit within and correspond with the thread of a taper screw of the mandrel.

"2d, The manner of holding together, or retaining in their places, the several segments of the expanding shell or nut, by means of a coiled spring or springs, encircling the segments, and made of sufficient length to admit of the nut expanding, without destroying the confinement or hold of the segments, as described."

11. For *Improvements in Machines for Stretching and Drying Cloth;* Thomas Barrows, Dedham, Massachusetts, December 2.

Claim.—"What I claim as my invention is, the combination of the two winding and lengthwise stretching contrivances, or stretchers, the two widthwise rotary stretchers, and the three or any other suitable number of drying cylinders, substantially as described, so as to enable a person to cause a piece of cloth to pass in one direction over and around the drying cylinders, and next in the opposite direction, as many times as may be desirable, in order to stretch, dry, and finish the same, to the extent that may be required."

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12. For an *Improvement in the Mode of Papering Pins;* Chauncey O. Crosby, New Haven, Connecticut, December 2.

Claim.—"I do not claim the crimps that the pins are inserted through; neither do I claim rolling up the paper of pins from both ends to the centre, that being old and well known. But what I do claim as my invention is, the new mode of papering pins, substantially as herein described. I claim the new manufacture of 'book pins,' formed by folding the paper in parallel folds at regular distances from each other, producing fan-like or zigzag folds, which allows the paper of pins to be closed into compact form, without rolling or winding, for the purposes herein set forth."

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13. For an *Improvement in Machines for Working Clay;* Daniel and George Duchemin, Cincinnati, Ohio, December 2.

Claim.—"What we claim as our invention is, 1st, the fixed double eccentric cams, I, I, in combination with the pitmans J, J^1, attached to the slides K, K^1, and by means of L, L^1, giving motion to the pawls M, M^1, and through them to the rack Q, and the wheel E, for the purposes herein set forth and described.

"2d, We claim the particular arrangement and combination of machinery set forth and described in figs. 2, 3, and 4, in combination with the tempering wheel E, fig. 1, especially the double eccentric I, I, and the pitmans or connecting rods J, and J^1, the slides K, and K^1, with the pawls M, M^1, the connecting bar O, the shifting rod P, and the rack Q, as applied to tempering clay, for making brick, or any other purpose, or any equivalent device or arrangement of machinery, for accomplishing the same purpose, substantially in the same manner."

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14. For an *Improvement in Tailors' Measures;* James Maginnis, Lockport, New York, December 2.

Claim.—"What I claim as my invention is, the gauge designated by the letters A and S, in the drawings; this gauge has two arms slit through the centre, from the cross bar down, as illustrated by fig. 1, in the drawings; the front arm extends up and forms a semi-circle over and around the top of the inner arm; this semi-circle is slit through the centre, and forms a way for the two shoulder straps, which are attached by a pivot to the top of the inner arm to turn on, with screws to set them to the desired place; the semi-circle is designated by the letter D, in the drawings; this gauge moves horizontally on strap E, from the front backward, or vice versa, until it strikes the front of the arm hole, and locates the same, and is set by screws to the desired place; again, this gauge can be drawn perpendicularly, so as to increase the length of the shoulder, for a very full breasted man, or contracted so as to fit a hollow breasted man."

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15. For an *Improvement in Winding Watches;* Theodore Noel, Memphis, Tennessee, December 2.

Claim.—"What I claim as my invention is, the application to watches, of the machine keys, substantially as herein described and illustrated by the accompanying drawings, which keys and their boxes are enclosed by the watch case and form a part of the watch, rendering the use of the ordinary watch key unnecessary, without the expense and great friction of the complicated machinery heretofore used for the same object."

16. For an *Improvement in Carriage Perch;* Lewis E. Stilwell, Franklinville, New York, December 2.

Claim.—"What I claim as my invention is, constructing the front extremity of the perch so as to form a spindle, which passes through a tube on the turning plate, to connect it with the front axle-tree, and at the same time to form a hinge, on which the front axle-tree can rock, the latter being a new duty additional to that which the forward extremity of the perch has heretofore performed; thus increasing the efficiency, without increasing the complexity or cost of the coupling."

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17. For an *Improvement in Machines for Boring Holes in Posts;* Thomas T. Strode, Coatesville, Pennsylvania, December 2.

Claim.—"Having thus described my improvements on the machine for boring holes in posts for fencing, what I claim therein as new is, combining the pivoted bar R, provided with a catch and inclined plate S T, and long arm V, and stop or pin *p*, with the gauge bar U, provided with rows of pins *g*, and mounted in bearings in the inclined carriage G, whereby the movement of the latter is regulated in moving the timber laterally in boring a series of holes as described in the specification.

"I also claim the combination of the pivoted beam P, inclined plane *b*, inverse half nut screw *f*, and propelling screw shaft M, whereby the carriages are made to advance toward the boring tool, and is disengaged, for the purpose and in the manner described and represented.

"I do not, however, intend to confine my claim to the precise construction described in the foregoing specification, but to use such a form of construction as may be the best adapted to accomplish the desired object by means substantially the same. Neither do I claim any portion of the machine above described, that has been practised successfully by others, prior to its being invented by myself."

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18. For an *Improved Foundry Apparatus;* Chapman Warner, Louisville, Kentucky, patented in England, October 1849; December 2.

Claim.—"Having thus described my improvements in the art of founding, what I claim therein as new is, 1st, The method of making moulds for castings, by impressing the pattern into a measured quantity of sand contained in a flask, constructed with steps or protuberances and depressions, substantially as herein described, so that the mould, when finished, may be surrounded by sand varying in thickness, in proportion to the different degrees of compression which it receives by the impression of the pattern, in order that the density or hardness of the face of the mould may be rendered more uniform, substantially as herein set forth.

"2d, I claim the method of charging the half flask with the requisite quantity of sand, to form a half mould, by surmounting said flask with a hopper, and passing the two to and fro beneath a sand box, substantially as herein described.

"3d, I claim the method of detaching the hopper from the flask after the mould is formed, and of applying it thereto before the sand is introduced, substantially as herein described.

"4th, I claim the method of applying facing sand to the flask, prior to the formation of the mould, by means of apparatus, substantially as herein described.

"5th, I claim the method of tempering, distributing, and sifting moulding sand by means of machinery operating substantially as herein described.

"6th, I claim the core spindle, constructed substantially as herein described.

"7th, I claim the method of filling a series of flasks with melted metal by a single sprue by means of a sprue case, with which the flasks are connected, substantially as herein set forth.

"8th, I claim the combination of apparatus for tempering the moulding sand apparatus for distributing the tempered sand, and sifting it into the sand reservoir, and apparatus for supplying to the flask a measured quantity of sand from the reservoir, with a flask and pressing apparatus, whereby the sand is worked and the mould produced by machinery operating substantially as herein set forth."

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19. For an *Improvement in Running Gear of Locomotives;* Ross Winans, Baltimore, Maryland, December 2.

Claim.—"What I claim as my invention is, the use of steel springs for the support of

the weight carried by the driving wheels of a locomotive engine, in combination with bearing or supporting wheels, placed both before and behind the aforesaid driving wheels, which bearing wheels support a portion of the weight of the engine, through the medium of steel, air, india rubber, or other springs, possessing the properties herein described as belonging to steel springs as distinguished from steam springs, for the purpose set forth in the specification.

"I also claim the employment of steam springs or steam pressure operating separately from the propelling cylinders, for the purpose of varying the pressure of the driving wheels of a locomotive engine upon the rail of the road, in combination with bearing or supporting wheels placed both before and behind the aforesaid driving wheels, which bearing wheels support a portion of the weight of the engine, through the medium of steel, air, india rubber, or other springs, possessing the properties herein described, belonging to steel springs, as distinguished from steam springs, for the purpose set forth in the specification."

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20. For an *Improvement in Apparatus for Opening and Closing Gates;* Enoch Woolman, Damascoville, Ohio, December 2.

Claim.—"Having thus described my improved gate, what I claim therein as my invention is, making a blank space on the lever *o*, and vibrating it so far as to disengage the cogs upon it from the cogs upon the plate *l*, so that the gate may be opened and closed by persons on foot without the aid and without operating the lever *o*, in combination with the connecting of the bar *d*, or latch, to the lever *o*, by the rope *g*, so as to unlatch the gate, when the lever *o*, vibrates before the cogs on the lever *o*, gear into the cogs upon the plate *l*, to open the gate, substantially as described."

MECHANICS, PHYSICS, AND CHEMISTRY.

Experiments on the Conducting Powers of Wires for Voltaic Electricity. By C. L. Dresser, *Esq.**

The instrument used in these experiments was the glass thread galvanometer of Ritchie, described in the Philosophical Transactions.† This instrument, though one of the most perfect kind, easy of construction, well adapted for the measurement of electro-magnetic forces, and extremely accurate, has not received that attention from scientific men to which the facility of its use entitles it. Requiring no calculation, a vast number of experiments may be read off in rapid succession.

A few alterations were made in its construction.

1. The graduated card placed under the needles was discarded as being no measure of the forces exerted, and a plain card with a black mark under the centre of influence of the conducting wires substituted. To this mark the needles were carefully adjusted at every experiment.

2. The graduated card at the top was enlarged to five inches diameter, and carefully graduated to degrees; and by an index traversing this card, the degrees of torsion necessary to bring the deflected needle vertical to the black mark on the lower card was read off easily to a fraction of a degree.

3. The graduated plate turned on its own axis, independently of the axis of the glass thread, rendering the adjustment of the needles easy and perfect.

4. The needles were considerably increased in size, and highly magnetized.

With these alterations, the action of the galvanometer was certain

* From the London, Edinburgh, and Dublin Philos. Magazine, September, 1851.

† Philosophical Transactions, 1850, p. 218.

and delicate, returning after even a deflexion of a thousand degrees, or three times round the card, with certainty to the index mark on the lower card; and the same experiment repeated corresponding to the fraction of a degree.

The battery used was my gas-carbon battery, and the following means were adopted to keep it constant:

1. The nitric acid cell was filled with the acid of commerce, but the zinc cell only half filled with dilute sulphuric acid.

2. The prism of carbon was suspended at its top to a rack-work, by which its immersion to a greater or less depth was regulated; consequently, any required amount of electricity obtained.

With these precautions, a constant current of electricity was maintained for hours; rarely varying, after effecting a torsion of three or four hundred degrees, one degree for hours. By this means also, at all times the same amount of current could be obtained, rendering it easy to recommence the experiments.

TABLE I.—*Battery power* 400. *Each wire was No.* 20.

Feet.	Copper wire.	Differences.	Feet.	Iron wire.	Differences.
1	398		1	330	
2	380	18	2	280	50
3	365	15	3	240	40
4	352	13	4	210	30
5	340	12	5	190	20
6	330	10	6	172	18
7	320	10	7	158	14
9	296	24	9	135	22
10	286	10	10	128	7
12	269	17	12	112	12
14	254	15	14	100	12
16	240	14	16	92	8
18	230	10	18	85	7
20	220	10	20	78	7
			22	73	5
			24	68	5
			26	64	4
			28	60	4

From the above table of experiments, it is evident that the often quoted law of the conducting power of wire being inversely as the length does not obtain in short lengths. But there is an evident intimation of some other law, and probably different for different metals.

Broke glass thread. New thread gives 300, without altering battery power.

TABLE II.—*One cell. No.* 16 *wire.*

Feet.	Copper.	Differences.	Iron.	Differences.
1	282		256	
2	275	7	235	21
3	268	7	217	18
4	262	6	200	17
5	256	6	187	13
6	148	5	175	12
7	138	5	164	9
8	133	5	157	7

From this table, compared with Table I., it does not appear that with a thicker wire there is any nearer approach to the old law, but also that some other law obtains.

TABLE III.—*No.* 16 *Wire. Battery power* 400. *Intensity two cells.*

Feet.	Copper.	Differences.	Iron.	Differences.
1	400		355	
2	391	9	320	33
3	382	9	294	26
4	476	6	270	24
5	370	6	252	18

Increase of intensity does not appear to approach near to the supposed law.

TABLE IV.—*Wire measured with a micrometer in hundredths of an inch. Battery power* 207. *One foot of wire. Diameter of galvanometer wire* ·740 *of an inch.*

Measure.	Copper: Current conducted,	Measure.	Iron: Current conducted.
370	190	360	129
480	195	510	65
700	206½	640	182
740	207	720	188

The wires of iron and copper on parallel lines were said to be of the same gauge, but the micrometer showed them to be of very different diameters. This table does not coincide with the law of the conduction of wires of different diameters being as the squares of their diameters.

Power of hydrogen to abstract the heat produced by the passage of electricity.

Battery power 410. Current through steel wire 175 hundredths of an inch.

Quantity conducted.

200 . . . . wire red-hot in air.

310 . . . . in hydrogen, and invisible in the dark.

In this experiment, battery power not observed.

Same wire as above.

In air red-hot 220

In current of air, quite cold 270

It would appear that the heating power of a current of electricity diminishes the power of conduction; also that hydrogen, by absorbing the heat, has the same effect as a current of cold air.

TABLE V.—*No.* 20 *wire placed in the air-bulb of sulphuric acid thermometer.*

Battery power.	Differences.	Current conducted.	Differences.	Degrees of heat.	Differences.
67		58		26	
92	25	73	15	44	18
107	15	84	11	75	31
124	17	91	7	90	15
145	21	100	9	124	34
170	25	102	2	143	19
202	32	108	6	160	17

These experiments, very tedious and difficult to conduct, do not appear to indicate any particular law.

Much in this department of electricity appears yet to be done, before we are able to define the laws of conduction, and there are many difficulties to be encountered. It is almost impossible to get wire of any length, of equal thickness and texture. It is also not easy always to obtain the same connexions, and the least variation in this respect vitiates the experiments. Some of the anomalies in the tables are to be traced to these causes.

A difference of temperature also, it appears, will affect conduction. Even bending the wire with so delicate an instrument as the torsion galvanometer, will affect the experiment; and twisting will alter its powers permanently.

On a New Blowing Engine, working at High Velocities. By Mr. Archibald Slate.*

At a former meeting, the writer laid before the Institution the opinions which he entertained on the subject of blowing cylinders, proposed to be driven at high velocities, concluding that there would result thereby a large economy in the manufacture of iron throughout the entire plant and appliances of this indispensable machine. (See *Artizan*, 1850, p. 203.)

It was observed in the former paper that, since the application of the double-acting movement, introduced some fifteen years ago, the blowing cylinder has remained, up to the present time, without a single other essential improvement. As left at that period, it continues a large and cumbrous machine, with complicated and slow motion; insomuch that the light and elastic body of the atmosphere is driven through at no higher velocity than the more ponderous body, water, can be passed through an ordinary pump. While the motive power was derived, in most instances, from a waterfall, there might indeed be alleged some semblance of a reason for the slow motion that has been spoken of; although, even in such circumstances, it is but little conceivable how the intervention of machinery, to quicken the passage of the lighter and elastic medium, should so long have remained a desideratum. But the question becomes infinitely more inexplicable, since the motive power employed has in almost every instance been steam, itself a medium in the highest degree light and elastic; capable, at the same time, of being worked under a pressure, and at a velocity, far beyond anything required at present, or that probably ever will be required of the air from a blowing cylinder.

Such being the facts, and contemplating the power and speed attained on the railway by locomotive engines, the writer was led to reflect that a similar power was at least capable of being applied to the blowing cylinder; and, while impressed with this train of thought, he had occasion, in the latter part of the year 1848, to make use of some small 9-inch cylinders, driven by air from a large blowing engine. It was then remarked, that these small engines, when driving shafts only, sometimes attained a velocity of 200 revolutions per minute, under the ordinary

* From the London Artizan for October, 1851.

blast pressure; when the idea suggested itself, that it might be possible to reverse their motions, making them blowing cylinders in place of air engines; and this idea, on being tested, turned out to be correct.

The cylinder experimented on was of nine inches diameter, and one foot stroke, and being driven at the rate of 320 revolutions per minute, discharged the air at 3½ lbs. per square inch, through a tuyere of 1¼th inch, being exactly $\frac{1}{85}$th part of the area of the blowing piston. This performance exceeds, as is well known, by double its amount, that of any ordinary engine; the total area of the tuyeres, with a 90-inch blowing cylinder, at a pressure of 3½ lbs., being about fifty circular inches, which is only $\frac{1}{144}$ part of the area of the blowing cylinder.

Assured by the complete success of this experiment, the writer proposed to construct a steam and a blowing cylinder of two feet stroke; the cylinder for steam to be of ten inches diameter, and that for blast of thirty inches; and to couple them, if necessary, with a second and similar set, acting at right angles upon a common axle; and he is still of opinion that such would probably prove the best arrangement, as well as the best proportions to observe in construction.

But in the actual experiment, the cylinders proposed to be placed at right angles have not yet been constructed. The size of that used, owing to peculiar circumstances, has been considerably enlarged. In 1850, finding that more air was required for the manufacturing purposes to which it was applied, the writer, and Mr. Cochrane, his partner, resolved to make a blowing cylinder of such a size as would practically test the question of high velocities; and a steam engine, having a cylinder of fourteen inches diameter, being ready at hand, was fitted with a 40-inch blowing cylinder, and to this engine the further remarks have reference. The stroke is two feet; the total weight of the engine about six tons; the boiler made use of weighed three tons, thirteen cwt.; its length over all is twenty-seven feet, having egg ends; its diameter four feet.

The first set of experiments were made in presence of Mr. Beyer, Mr. M'Connell, Mr. Daniel Gooch, Mr. Geach, Mr. Evers, Mr. Cochrane, and several other gentlemen who took an interest in the proceedings, which were of the following nature.

On the outlet pipe were placed four tuyeres: two of them 2¼ inches diameter, and the remaining two 2 inches diameter, all blowing into the open air. The engine being run up to its full velocity, reached 145 strokes per minute. At this rate, the density of the air issuing from the four tuyeres approached nearly to five lbs. per inch, the engine remaining perfectly noiseless and steady, and the blast being so continuous and regular, that the mercury in the barometer did not vary more than one-eighth of an inch—in fact, continued barely living in the tube.

A variety of minor experiments followed, not necessary to be dwelt upon at present; but it is believed perfectly warrantable to state, as the result, that each person present felt convinced that he had seen exhibited a blowing machine of at once a powerful, cheap, and efficacious character.

Although the experiments thus detailed were of the most satisfactory description, and indeed had exceeded every expectation of a first performance, the writer nevertheless felt convinced, from observation of the working, that the steam might be considerably economized; and before

proceeding to apply it to actual use, resolved to fit the engine with an adjusting expansive valve, by which such economy might be realized. When this had been fitted, and the requisite attachments made, its full complement of blast was thrown into one furnace, viz.: 3500 cubic feet of air per minute; the pressure of the air in the main, close upon the engine, was a little in excess of three lbs. to the inch; at the tuyeres on the furnace, it was, if anything, rather under three lbs.: but this slight discrepancy probably took its origin from the tortuous character and length of the main, which exceed 300 feet; a circumstance which it was found impossible to avoid, without leaving out of consideration the objects to which the new blowing power is ultimately to be applied.

The engine, during the trial, varied from 96 to 100 strokes per minute. The steam from the one small boiler, 27 feet by 4, remained full and sufficient for this work, after the engine had worked every day for nearly a month, and had been seen by Mr. Benjamin Gibbons, and several other persons connected with the iron trade. An opportunity again occurred of trying it upon one furnace, with the same result as above; this last experiment was made in the presence of Mr. Samuel Blackwell. With regard to fuel, on a subsequent trial, while working in connexion with a larger blowing engine of the ordinary sort, delivering into the mains 3000 cubic feet of air, at a density of 3¼ lbs. to the inch, it was found to amount, by measurement, to two tons five cwt. of small refuse coal or slack, in twelve hours.

Although the writer does not present the arrangement of the engine, here given, as a perfect machine, he can entertain no doubt that the development of the principle must greatly stimulate the production of iron. It will be perceived how, by the use of blowing machines, working at high velocities, the expense of plant and machinery for blowing a furnace may be reduced, at the rate of sixty-five per cent., from what it stands at present; or, to one-third of the present amount. The above-mentioned experiments at Woodside have proved such engines to be adequate to as large a class of works as exist in Staffordshire. Their simplicity and portable character make them equally available at the smallest charcoal furnaces, in however remote a quarter there might be occasion for their use.

Mr. Middleton inquired, whether the blast from the small engine went direct to the furnace, or through a reservoir?

Mr. Slate said, they had a receiver, twelve by four feet; but in the experiment with one furnace, when the other was in repair, they let it blow through the whole of the large air main.

Mr. Middleton said, that he remembered the late Mr. Murdock worked a similar blowing engine at Soho, twenty-five years ago; it was direct-acting, and the only difference was that it had a D valve, and worked at a slower velocity than Mr. Slate's engine.

The Chairman said, he had a similar blowing engine in regular work at Wolverton, only working vertically instead of horizontally; but his engine only made from fifty to sixty strokes per minute, while that now under description performed one hundred and thirty in the same time. This gave the blowing engine of Mr. Slate a great advantage, and was its distinctive feature; the great gain was in the high speed employed.

Mr. Davies observed, that Mr. Slate's engine could give a steady blast for a furnace, with full pressure, which Mr. Murdock's engine could not do.

Mr. Slate remarked, that though Mr. Murdock's engine had been at work at Soho for the period stated, no further progress had been made in the construction of the blast engine; for at Soho they still continued to make only the old ponderous engines.

Mr. Middleton said, it had been applied at the smithy at Woolwich, and had been at work there for many years. He thought, though Mr. Slate's engine was different in some respects, it was similar in principle to Mr. Murdock's.

Mr. W. Smith was quite satisfied that Mr. Slate's engine would maintain a constant blast for a furnace. He had seen Mr. Murdock's engine at work; it was an open-top cylinder, and was quite another kind of engine. He thought that Mr. Slate's plan of blowing engines was an important advantage in the saving of expense in the erection of iron works, and he believed that a blowing engine could now be erected for £500 on that plan, as well as one on the old plan for £1500, to do the same work.

The Chairman thought that Mr. Slate's engine was certainly deserving of approbation, and he hoped that he would continue his investigation of the subject, as any improvement or economy in the manufacture of iron was of great importance.

On the Use of Electro-magnets made of Iron Wire for the Electro-magnetic Engine. By J. P. Joule, Esq. *Communicated in a Letter to the late* Mr. Sturgeon.*

Dear Sir: In my last letter I gave you an account of some experiments which were intended to prove that electro-magnets made of iron wire are the most suitable for the electro-magnetic engine. In those experiments round wire was used; and it was my opinion that the wire magnets were put in a disadvantageous position, in consequence of the interstices between the wires. I have since confirmed my views on this subject by the following experiment:—

I constructed two magnets. The first consisted of sixteen pieces of square iron wire, each $\frac{1}{11}$th of an inch square and 7 inches long, bound very tightly together so as to form a solid mass, whose transverse section was $\frac{4}{11}$ths of an inch square; it was enveloped by a ribbon of cotton, and wound with sixteen feet of covered copper wire, of $\frac{1}{18}$th inch diameter. The second was made of solid iron, but was in every other respect precisely like the first. These magnets were fitted to the apparatus used in my former experiments, and care was taken to make the friction of the pivots equal in each. The mean of several experiments gave 162 revolutions per minute with the first, and 130 with the second magnet.

In the further prosecution of my inquiries, I took six pieces of round iron of different diameters and lengths, and also a piece of hollow round iron, half an inch in diameter, and $\frac{1}{13}$th of an inch thick in metal; these were bent into the U-form, so that the shortest distance between the poles of

* Annals of Electricity, vol. iv. p. 58.

each was half an inch; each was then wound (with the usual precautions to ensure insulation) with ten feet of covered copper wire of $\frac{1}{30}$th inch diameter. The lengths and diameters are given in the following table. No. 1 is the hollow magnet. The attraction was ascertained by suspending a straight steel magnet, 1½ inch in length, horizontally to the beam of a balance, and bringing the several electro-magnets directly underneath at the distance of half an inch, which was preserved by the interposition of a piece of wood half an inch thick. Care was taken that the battery remained constant during the experiments.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
Length in inches, . .	6	5½	2¾	5½	2½	5½	2½
Diameter in inches, . .	½	½	½	⅜	⅜	¼	¼
Weight lifted in ounces, .	36	52	92	36	52	20	28
Attraction for steel magnet in grains,	7·5	6·3	5·1	5·0	4·1	4·8	3·6

A steel magnet of such dimensions as enabled me to compare it fairly with the electro-magnets, was found to exert an attraction of 23 grains for the small steel magnet, though its lifting power was only 60 oz.

These results will not appear surprising if we consider, first, the resistance which iron presents to the induction of magnetism; and secondly, how very much the power of iron to conduct magnetism is exalted merely by the completion of the ferruginous circuit. In order, however, to explain why the long electro-magnets have a *greater* attracting power at a distance, though they lift *less* weight, than the short magnets of the same diameter, it will be necessary to observe that it was impossible to wrap the whole ten feet of wire on the smaller magnets, without disposing it in two or three layers (according to the size of the magnets.) This was a great disadvantage; and one might have anticipated in consequence, that the power of the long magnets would be greater than that of the short ones for lifting, as well as distant attraction, which is contrary to the results of the table; this may however be explained, if we admit that the comparative resistance of the iron of the electro-magnet increases to a very great amount, when its magnetism is so greatly excited as by the contact of the armature.

Nothing can be more striking than the difference between the ratios of lifting to distant attractive power, in the different magnets; whilst the steel magnet attracts with a force of 23 grains and lifts 60 oz., No. 3 attracts 5·1-grains and lifts 92 oz.

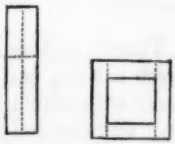
The following are some general directions for making electro-magnets for lifting:—1st, The magnet, if of considerable bulk, should be compound, and the iron used of good quality and well annealed. 2d, The bulk of the iron should bear a much greater ratio to its length than is generally the case. 3d, The poles should be ground quite true, and fit flatly and accurately to the armature. And 4th, The armature should be equal in thickness to the iron of the magnet.

I shall now proceed to consider with greater care what form of electro-magnet is best for distant attraction, as that is the only force of any use in the electro-magnetic engine. Here two things must be considered; the length of the iron, and its sectional area.

Now with regard to the length of the iron, I have found that its in-

crease is always accompanied with disadvantage, unless the wire is (by using a shorter length) forced to too great a distance from the iron. In making magnets for an engine, it will be proper to use a length less than that which gives the maximum of attraction, on several accounts.

The next thing to be considered is the sectional area. You have shown* that, on placing a hollow and solid cylinder of iron successively within the same electro-magnetic coil, the hollow piece exerted the greatest influence on the needle. I wished to ascertain whether a hollow magnet could be represented by a solid one, of which the sectional area and circumference are the same, and the thickness of which is twice that of the hollow magnet. The accompanying figures represent sections of hollow and solid rectangular magnets; and it will be seen, that if either of them is divided at the dotted lines, the separate pieces, when put properly together, will make up the other. Two electro-magnets were constructed, each 7 inches long, and wound with twenty-two feet of insulated copper wire; the sections were similar to, but twice the size of the figures. Their attractions at half an inch distance for the contrary pole of a straight steel magnet were as follows:—



	Hollow magnet.	Solid magnet.
Attraction in grains, . .	1·9	1·7
Do. with a more powerful battery, .	4·5	4·0

The above results show that the hollow magnet has the greater attractive force; but I do not think that the difference between the two is so great as to counterbalance the practical advantages which solid bars would give if used in the engine. I shall now therefore attempt to determine the sectional area of solid iron most proper for various galvanic powers.

I made five straight electro-magnets of square iron wire $\frac{1}{11}$th of an inch thick; each was 7 inches long, and wound with twenty-two feet of insulated copper wire of $\frac{1}{16}$th of an inch diameter. No. 1 consisted of nine, No. 2 of sixteen, No. 3 of twenty-five, No. 4 of thirty-six, and No. 5 of forty-nine square iron wires, arranged in the form of square prisms. Five other electro-magnets were made of square iron rod, but in every other respect were exactly similar to the first. The following are the attractions (at half an inch distance) for a straight steel magnet, with three different voltaic forces:

		No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
1st experiment.	Attraction of iron bar magnet in grains,	1.5	1·9	1·6	2·1	2·0
	Ditto of wire magnet,	2·1	2·1	1·7	2·0	1·9
2d experiment.	Iron bar magnet,	2·0	2·5	2·35	2·45	2·2
	Wire magnet,	2·6	2·8	2·1	2·2	2·05
3d experiment.	Iron bar magnet,	2·7	3·6	3·4	3·2	3·1
	Wire magnet,	3·3	3·8	3·0	2·9	2·65

The square iron wire of which the wire magnets were constructed, was taken at the same degree of temper that it possessed when it came

* Annals of Electricity, vol. i, p. 470.

from the manufacturer. It was in consequence not so well annealed as the iron bars. On this account the numbers opposite the wire magnets are less than they would have been with better annealed wire: still the results of the table seem anomalous; for it will be remarked, that whilst the wire magnets are the most powerful of the smaller electro-magnets, the bar magnets are most powerful of the larger ones.

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Action of the Sea-Worm on Timber, and the Best Means of Protection. By SAMUEL CLEGG, JUN.*

Timber exposed in marine works is subject to be destroyed by the *teredo navalis*, and *limnoria terebrans*. The *teredo*, by means of auger-like shells with which its head is furnished, bores into the timber, and forms long circular holes, lining them with a shelly substance. These worms are very numerous, and the timber attacked by them soon assumes the form of a honeycomb. They appear to penetrate all kinds of timber; that which it seems to destroy with the greatest ease is fir, in which it works more speedily and successfully than in any other, and perhaps grows to the greatest size. In a fir-pile taken from the old pier-head at Southend, a worm was found 2 feet long and ¾-inch in diameter, and they have been heard of 3 feet and 4 feet in length, and 1 inch in diameter. In hard wood they do not grow so large. Wood which has been perforated presents to casual observation no symptom of destruction on the surface, nor are the animals themselves visible until the outer part of the wood has been broken away, when their shelly habitations come in sight, and show the perfect honeycomb they have formed. On a close examination of the wood, however, a multitude of very minute perforations are discovered in the surface, generally covered with a slimy matter; and on opening the wood at one of these, and tracing it, the tail of the animal is immediately found, and after various windings and turnings the head is discovered, which in some cases is as much as 3 feet from the point of entrance. Sometimes it will happen, especially if the wood has been much eaten, that their shelly tubes are partly visible on the surface, but this is rare. They enter at the surface, and bore in every direction, both with and against the grain of the wood, growing in size as they proceed.

The *limnoria terebrans* is a minute crustacean, similar in appearance to a woodlouse, and confines its destructive operations to the surface of the wood, so that what is left undestroyed by the teredo is completed by the limnoria. On the surface of a piece of wood, only 12 inches square, Mr. Paton estimated no less than 54,000 different perforations, caused by this little creature penetrating to about an inch from the surface.†

The teredo enters the timber at various heights of the tide, sometimes confining their operations between low water mark of neap tides and the bottom of the river, occasionally piercing below the ground; and at others, attacking the wood 8 or 10 feet above low water, to 2 feet below the bed of the sea. They, however, appear gradually to relax in their destructive

* From the London Architect for October, 1851.

† They are said not to attack teak, but this is doubtful.

habits from low water towards high water. The limnoria attacks the timber higher up than the teredo, and have been found at 2 feet below high water mark.

At Southampton, piles 14 inches square have been eaten down to 4 inches in four years. At Southend old pier, the teredo showed itself in six months after the completion of the work; and in four years many of the piles, from 12 to 14 inches square, were eaten through. A pair of dock gates at Hartlepool were destroyed in eight years. At Sheerness, after a time, it was no uncommon thing to see several piles, apparently sound, floated away at each tide; indeed, they were so thoroughly perforated by the teredo, that in still weather, by putting the ear to the side of the pile, the worms could be heard at their boring labors.

Cold-blooded animals are not affected by poisons; for instance, a frog cannot be killed with prussic acid. The teredo is an animal of a much lower order than the frog, therefore it might be inferred that the impregnation of timber with creosote, or other poisonous matter, will not protect it from their ravages; but, from observation, it appears that creosote does protect the wood, to some extent at all events. A piece of unprepared timber, 800 feet from the beach at Lowestoft, was taken from a guide pile which had been left after the work was completed; it was sawn off below low water mark of neap tides, and it was evident that whilst the limnoria was attacking the surface, the teredo was destroying the interior; at the same depth, and close adjoining to the guide pile, a piece of creosoted permanent pile was sawn off, which was perfectly sound.

A most searching examination, occupying many days, was made upon every pile in Lowestoft harbor, by the direction of Mr. Bidder. There was no instance of an uncreosoted pile being sound—they were all attacked, both by the limnoria and the teredo to a very great extent, and the piles in some instances were eaten through. All the creosoted piles were quite sound, being neither touched by the teredo or the limnoria, though covered with vegetation, which generally attracts the teredo. Some creosoted timber put into Teignmouth harbor by Mr. Brunel, was found untouched by the worm after seven years; whereas all the unprepared timber was more or less affected. It may be, that the creosote being nauseous prevents the worm from attacking the timber. The cost of creosoting railway sleepers is about $4\frac{1}{4}d.$ per cubic foot; that of preparing timber to resist the ravages of the worm is nearly $6d.$ per cubic foot.

The mechanical means adopted for the protection of timber from the sea-worm, are sheathing with copper, studding with iron scupper nails, and casing with cast iron.

Copper sheathing was used at Southend, but the limnoria not only penetrated between the copper and the timber, but the copper itself rapidly decayed; therefore this is not a method to be imitated.

Wrought iron nails, with heads about one inch square, driven into the piles close together, is an effectual preservative; the iron corrodes, and forms a solid impenetrable rust entirely over the timber. The cost is about $11d.$ per superficial foot. Casings of cast iron are not more effectual, and are much more costly.

A plan stated to be effectual at the Herne Bay pier, may be employed in countries where the above modes cannot be followed. A wooden

casing was formed round each pile, leaving a space of about an inch all round, which was rammed full of lime or cement concrete; the worms commenced their ravages, but appeared to have been checked, and not to have been able to exist when so enclosed.

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*The Philadelphia and Liverpool Screw Propeller Steam Navigation Company's New Iron Vessel, "City of Manchester."**

Built and fitted by Messrs. Tod and McGregor, engineers and iron ship-builders, Glasgow, 1851.

	British.	American.
Builder's Measurement.	Tons.	Tons.
Hull	1776 7/94	1756 1/95 3/5
Contents of engine-space	568 9/94 2/4	563 0/95 5/5
Ditto of shaft tunnel	10 5/94 5/5	10 4/95 8/5
Register	1197 3/94	1184 5/95 7/5
		British Act for Foreign Vessels.
New Measurement.	Ft. Ins.	Ft. Ins.
Length on deck	261 8	261 8
Breadth on ditto, amidships	36 2	36 2
Depth of hold, ditto	25 3	25 3
Length of engine-room	77 7	77 7
Ditto of shaft-tunnel	79 7	79 7
Breadth of ditto	5 0	5 0
Depth of ditto	6 9	6 9
Tonnage.	Tons.	Tons.
Hull	2109·81	1844·83
Contents of engine-room	770·15	770·01
Ditto of shaft-tunnel	29·75	29·75
Register	1309·91	1044·78

A pair of engines (beams at top) of 366 horses nominal power; diameter of cylinder 71 inches × 5 feet length of stroke; two-bladed screw, diameter 14 feet; pitch 18 feet; driving wheel, diameter 9 feet 10 inches; 93 cogs; pinion diameter 4 feet 5 inches, 42 teeth; pitch 4 inches; 4 sets of cogs, 9 inches in breadth and 1½ inches between them; 3 tubular boilers; 9 furnaces, and 448 tubes in all; chimney 6 feet × 30 feet; 2 iron masts, fore ditto 81 feet, and second 83 feet long, and both are 2 feet 2½ inches in diameter; frames of hull, 5 × 3 × 5/8 inches, and 18 inches apart; propeller frame 7¼ inches square; keel 9 × 3½ inches; plates 7/8 to 3/8 of an inch in thickness. Has accommodations for 180 passengers; and is manned by a crew of 86 men, 14 of which are in the engine-room. Sailed from Greenock for Belfast on the 16th of July last; arrived there in 8 hours and 10 minutes; at the rate of 13 miles per hour; sailed from

* From the London Artizan, for October, 1851.

Belfast for Liverpool (156 miles), arrived at the latter in 12 hours and 55 minutes; draft of water, forward, 12 feet, and 14 feet 6 inches aft; steam pressure 10 lbs. per square inch; the engines making an average of 25 revolutions per minute.

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*The Glasgow and New York Screw Steam Navigation Company's Iron Vessel "Glasgow."**

Built and fitted by Messrs. Tod and McGregor, engineers and iron ship-builders, Glasgow, 1851.

Dimensions,	Ft.	Ins.
Length on deck	250	0
Breadth on ditto, amidships	35	2
Depth of hold, ditto	26	2
Length of tunnel for screw-shaft	74	0
Breadth of ditto	5	0
Depth of ditto	7	2
Length of engine-space	78	2

Tonnage.		Tons.
Hull		1,961·78
Contents of tunnel for screw-shaft,	28·83	
Ditto of engine-space	780·51	
		783·34
Register		1,152·53

A pair of engines (beams at top) of 366 horses nominal power; diameter of cylinders 71 inches × 5 feet; diameter of driving-wheel 9 feet 10 inches, having 93 cogs; diameter of pinion 4 feet 5 inches, having 42 teeth; pitch 4 inches; 4 sets of cogs; three-bladed screw, of cast-iron, 14 feet diameter; pitch 18 feet. Is fitted with Messrs. Lamb and Summers' patent sheet flue boilers, 3 in number; length 13 feet 2 inches; breadth 9 feet 3 inches; depth 15 feet 9 inches; 63 spaces, 21 in each boiler, and 7 opposite each furnace; length 7 feet; breadth $1\frac{3}{4}$ inch; depth 3 feet 6 inches; 9 furnaces, 3 in each boiler; length 7 feet 3 inches; breadth 2 feet 4 inches; depth 4 feet; chimney 6 feet × 30 feet; frames of hull $5 \times 3 \times \frac{5}{8}$ inches, and 18 inches apart; keel $8\frac{3}{4} \times 3\frac{1}{2}$ inches; propeller-frame $7\frac{1}{4}$ inches square; 2 iron masts; the foremast is 81 feet long, and the second is 83 feet long, and 2 feet $2\frac{1}{2}$ inches diameter: they are painted in imitation of wood. She will carry a cargo of 1763·36 tons, (which includes 600 tons of coals, stores, &c.,) and has accommodations for 170 passengers.

She was launched from the building-yard, Meadowside, on Saturday, the 16th of August, the draft of water being, forward 6 feet 9 inches, aft 7 feet 7 inches. On the trial trip, September 5th, she sailed out as far as Pladda, and went from the clock to the Cumbrae light-houses (a distance of 15·6 miles) in 74 minutes, or at the rate of $12\frac{1}{2}$ miles per hour, having a plentiful supply of steam, the screw making about 60 revolutions per minute. The *Glasgow* sailed from the Clyde to New York on

* From the London Artizan, November, 1851.

the 16th of September, on the first voyage outward, being only one month from the launch to day of sailing.

For the Journal of the Franklin Institute.

Notes on the U. S. Steamer "Iris." By Chief Engineer, B. F. ISHERWOOD, *United States Navy.*

The U. S. Steamer "IRIS" was originally a vessel bought into the Navy from the merchant service in 1847. She made but one short cruise to the Gulf of Mexico, when, proving entirely unadapted for naval purposes, she was sold out of the service, and under the name of the "OSPREY," now plies between Philadelphia and Charleston.

HULL.—Length on deck, 145 feet; breadth of beam, 27 feet; depth of hold, 11 feet; burthen, 388 tons; immersed amidship area of hull, 229 square feet; mean draft of water, 9 feet 9 inches.

ENGINE.—One piston rod, condensing steeple engine; diameter of cylinder, 54 inches; stroke of piston, 6 feet; space displacement of piston per stroke, 95·424 cubic feet.

PADDLE WHEEL.—Of the common radial kind; diameter 23 feet; number of paddles in wheel, 20; length of paddle, 6 feet; breadth of paddle, 2 feet 4 inches; area of one paddle, 14 square feet; mean immersion of lower edge of paddle, $3\frac{1}{4}$ feet; $4\frac{1}{2}$ paddles in water with centre paddle vertical.

PERFORMANCE.—The logs of the vessel give her performance for 445 hours steaming, using anthracite coal with a fan blast; and for 552 hours steaming, using bituminous coal with a natural draft.

The mean of her performance with anthracite coal was as follows: Speed of vessel, 6·586 knots of $6082\frac{2}{3}$ feet per hour; double strokes of piston per minute, 11·512; steam pressure in boiler above atmosphere, 21·8 pounds; anthracite coal consumed per hour, 946 pounds. Throttle one-fourth open; steam cut off at half stroke.

The mean of her performance with bituminous coal was as follows: Speed of vessel, 6·824 knots per hour; double strokes of piston per minute, 12·491; steam pressure in boiler above atmosphere, 12·5 pounds; bituminous coal consumed per hour, 1025 pounds; throttle wide open; steam cut off at half stroke.

The mean speed of vessel for the entire 997 hours, was 6·718 knots; double strokes of piston per minute, 12·054.

Owing to the *throttling off* when the anthracite was used, it is impossible to tell, in the absence of indicator diagrams, with any approach to reasonable accuracy, what was the initial steam pressure in the cylinder; the comparison of the relative economical evaporation of the two kinds of coal must be made from the weights of coal consumed per hour, and the cubes of the speeds of the vessel (supposing the resistances to the vessel to be the same,) as the measure of the effects. Because the powers will be as the steam used, (supposing the same back pressures in the cylinders in both cases,) the same degree of expansion for the steam being employed in both cases; and the powers are measured by the cubes of the speeds.

The consumption of coal in the two cases is 946 pounds and 1025 pounds per hour; the speeds 6·586 knots and 6·824 knots per hour; reducing these to proportionals, we have

Anthracite, 1·0000	Speed, $1·0000^3 = 1·0090$
Bituminous, 1·0835	" $1·0361^3 = 1·1122$

whence it appears that the economical evaporation of the bituminous is $(\frac{1·1122}{1·0090})$ better than the anthracite's in the proportion of 1·0265 to 1·0000.

As, however, both the resistances to the vessel, owing to variations of draft and variable conditions of sea and weather, and the back pressure in the cylinder, constantly varied, though within such slight limits that the means on which the comparison is founded, probably present a correct relation; yet we are not entitled with so trifling a difference as the result shows, to conclude practically, other, that in the boilers of the Iris, both kinds of fuel produced equal effects. There is no reason for supposing that the losses of heat by *foaming* or *priming*, leakage of the cylinder valves and piston, and by *blowing off*, were not the same in both cases. The anthracite also furnished the steam for the small engine driving the fan blower, which effect is not included in the above calculation.

Power.—The actual power developed by the engine can be obtained with sufficient accuracy, from the data, when using bituminous coal. The throttle being wide, the initial cylinder pressure would be about 2 pounds less than the boiler pressure. The space comprised between the steam valve (which was also the cut off valve) and piston, including clearance, &c., is 2·464 cubic feet, or equivalent to a cylinder of 54 in. diameter, and 0·154 foot long. The steam was cut off at half stroke of piston; the boiler pressure was 12½ pounds above the atmosphere, and allowing the initial cylinder pressure to be 2·2 pounds less than the boiler pressure; the total initial cylinder pressure would be 25 pounds per square inch; 3·154 of this steam would be expanded into 6·154, and give a mean pressure throughout the stroke of 21·31 pounds. The back pressure in the condenser was per gauge, 2·2 pounds, and allowing the back pressure in the cylinder to exceed it by 2.11 pounds, there would be a total of 4·31 pounds back pressure to be deducted, leaving the mean effective pressure throughout the stroke, (21·31—4·31,) 17 pounds per square inch.

$$\frac{2290·22 \text{ ar. cyl. in sq. in.} \times 17 \times 12·491 \text{ double st. pist. per. min.} \times 12 \text{ ft. length double stroke.}}{33000}$$

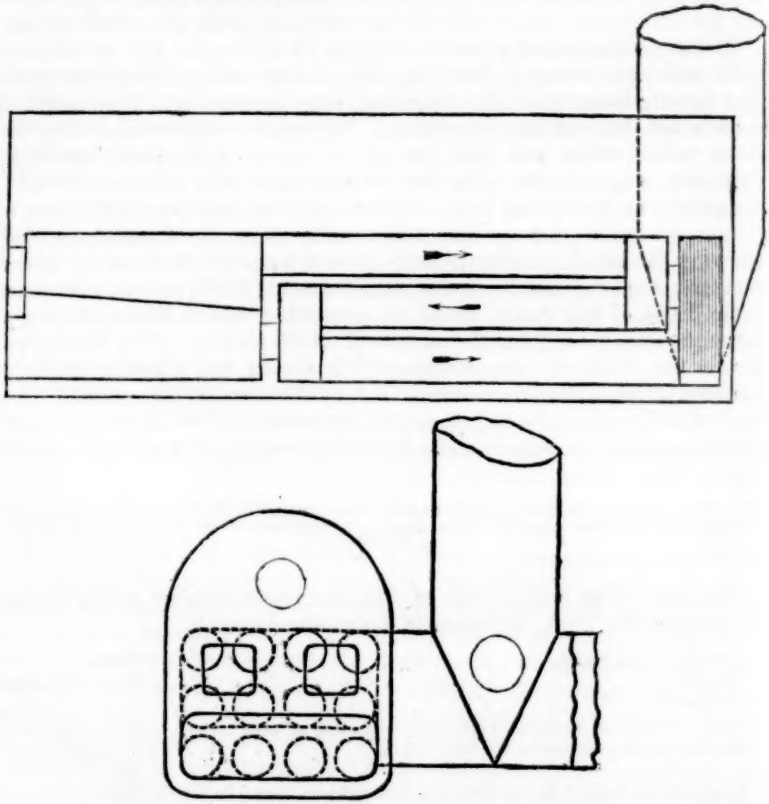
= 176·844 horses power.

Boilers.—The boilers were of iron, and two in number, of the double return drop flue kind, as shown in the annexed sketch.

Length of each boiler,	23 feet.
Breadth of "	6 feet 10 inches.
Height of "	8 " 3 "
Cubic contents of circumscribing parallelopipedon of each boiler,	1296⅜ cubic feet.
Area of heating surface in the two boilers,	1420 square feet.
" grate " " "	80 "
Cross area of each of the three rows of flues (14½ in. diam.) in the two boilers,	9·17 "
Cross area of smoke chimney,	11·54 "
Height of smoke chimney above grate,	40 feet.

PROPORTIONS.

Proportion of heating to grate surface,	17·75 to	1·000
" grate surface to cross area of each of the three rows of flues in the two boilers,	8·724 to	1·000
" " " smoke chimney,	6·932 "	
" heating " each of the three rows of flues in the two boilers,	154·853 "	
" " " smoke chimney,	123·050 "	
" " cubic foot of space displacement of pist. per double stroke of piston per minute,	14·881 "	
" grate " " "	1·191 "	
" " " space displacement of pist.	0·067 "	
Consumption of bituminous coal with natural draft per square foot of grate surface per hour,	0·838 "	
" anthracite " fan blast	12·812 pounds.	
" bituminous " natural draft heating	11·825 "	
" anthracite " fan blast	0·722 "	
Sea water evaporated by one pound of bituminous coal per hour,	0·666 "	
Sea water evaporated by one square foot of heating surface per hour, burning bituminous coal,	5·118 "	
	3·624 "	



The steam being cut off at half stroke of piston, there would be filled per stroke ($\frac{95·421}{2}$) 47·712 cubic feet, to which must be added 2·464

cubic feet comprised between the cut off valve and piston, making 50·176 cubic feet, which, multiplied by the number of strokes per minute, viz: 24·982, and then by 60, gives 75209·81 cubic feet of steam of 25 pounds per square inch total pressure per hour. The relative volumes of steam of this density and water, is as 1044 to 1, and $75209{\cdot}81 \div 1044 = 72{\cdot}04$, which, multiplied by 64·3 pounds, the weight of a cubic foot of sea-water, gives 4632·172 pounds of sea-water evaporated per hour by 1025 pounds of bituminous coal, or 4·519 pounds of water per pound of coal. To this must be added the loss by blowing off, obtained as follows:

The density of the water in the boiler being carried at $\frac{2}{32}$ of *Sewell's Salinometer*, one-half of the whole quantity pumped into the boiler would be blown out, leaving the other half to be evaporated. The water was furnished to the boiler from the reservoir, at a temperature of 100° F.; the temperature of the steam, and consequently of the water in the boiler, corresponding to a total pressure of 27·2 pounds, was 246° F.—the loss of heat in the blown out water was therefore 146° F. The total heat of steam being taken at 1202° F., and the temperature of the feed water being 100° F., there was left to be furnished by the fuel 1102° F. The total quantity of heat then furnished by the fuel was $146 + 1102 = 1248$° F., of which 146° was lost by *blowing out*, and 146 is 11·7 per cent of 1248. Out of every 100 of fuel burnt, there is then 11·7 lost, and 88·3 utilized; and if 88·3 give 4·519, 100 would give 5·118. There was therefore evaporated by each pound of bituminous coal, 5·118 pounds of sea-water.

Proceeding in the same manner, there will be found to be evaporated per hour, per square foot of heating surface, 3.624 pounds of sea-water.

As it is possible to attain an evaporation of 8 pounds of water per pound of coal in marine boilers of proper proportions, let us examine why the boilers of the "Iris" gave so inferior a result.

The first essential is, that the fuel be supplied with a sufficient quantity of atmospheric air to oxidize the components of the fuel, and this quantity will mainly be determined by the cross area of the flues or *calorimeter*, modified by amount of heating, or heat absorbing surface and height of smoke chimney.

With the proportion of heating to grate surface of $17\frac{3}{4}$ to 1, and a consumption of 12.812 pounds coal per square foot of grate per hour, the heated gases would be delivered into the chimney at the temperature of about 420° F., the chimney being 40 feet high above the grate, the velocity of draught calculated from Buchanan's formulæ would be 25.8 feet per second.

According to the experiments of Professor Walter R. Johnson on Maryland bituminous coals, the kind used with this boiler, there are required for the perfect combustion of one pound, 237·21 cubic feet of atmospheric air at standard temperature of 60° F., and pressure of 30 inches barometer; there would consequently be required to enter the grates per hour ($237{\cdot}21 \times 12{\cdot}812 \times 80$) 243,130·76 cubic feet of air, which will contain 48,626·15 cubic feet of oxygen entering into chemical combination with the constituents of the coal.

Of the combined oxygen, the portion that enters into chemical combination with the fixed carbon, compared to that which enters into chemical union

with the bitumen of the coal, (supposing, as is the case with Maryland coals, that the fixed carbon is 75 per cent., and the bitumen 14 per cent., the remainder being earthy matters, &c.,) is in the proportion of 200 to 112; consequently there would unite with the fixed carbon 31,170·6, and with the bitumen 17,455·55 cubic feet of oxygen; and as carbon unites with oxygen by volume in the proportion of $\frac{1}{2}$ to 1, the sum of the volumes would be 46,755·9 cubic feet, which by that union condenses into the original volume of oxygen, viz: 31,170·6 cubic feet.

As hydrogen, the principal constituent of the bitumen, requires only one volume of oxygen to two volumes of itself, the resulting bulk would be 52,336·65 cubic feet, which by the chemical union condense into the original bulk of the hydrogen, viz: 34,891·1 cubic feet.

After the deduction of the 48,626.15 cubic feet of oxygen from the total bulk of air required, viz: 243,130·76 cubic feet, there remains 194,504·61 cubic feet of uncombined nitrogen.

The bulk of gases in the cold state, required to pass through the flues of the boilers per hour, would be $243{,}130{\cdot}76 \times 31{,}170{\cdot}60 \times 34{,}891{\cdot}10 = 309{,}192.46$ cubic feet.

Supposing the temperature of the air entering the ash-pits to be 60° F., and that of the heated gases entering into the flues 1060° F., the gases would have received 1000° of temperature; and as the fixed airs expand $\frac{1}{179}$th their bulk for each degree of temperature, the 309,192·46 cubic feet would be increased to 954,688·20 cubic feet.

Now the cross area of the flues is 9·17 square feet, and the velocity of the draft in the chimney per hour is $(25{\cdot}8 \times 60 \times 60)$ 92,880 feet, the bulk of gases passed per hour is then $(92{,}880 \times 9{\cdot}17)$ 851,709·6 cubic feet. Consequently the calorimeter is not large enough to pass the proper amount of air by 12 per cent. were the combustion *perfect;* that is, did *all* the oxygen enter into *full* chemical combination with the constituents of the coal.

In practice, however, this is impossible to effect, from want of time and sufficient mixing of the gases, so as to bring molecule of oxygen in contact with molecule of coal constituent; and analyses of the products of combustion taken from the flues of steam boilers show that 50 per cent. of the entering oxygen passes off uncombined. In *practice*, therefore, the calorimeter should be made double the *theoretical* dimension. The proportion of calorimeter to grate in the boiler of the "Iris" is 1·000 to 8·724; more than double this proportion, or about 1·000 to 4, would therefore be a proper dimension in practice, burning the same amount of coal per square foot of grate per hour.

After having generated the caloric most economically by such a proper proportion of the calorimeter as would allow the oxygen to be present in sufficient quantity to ensure the saturation of the coal constituents, the next thing to be done is to provide a sufficient quantity of heat absorbing surface to conduct it into the water. Here again a much higher proportion than what is usually given in practice, will be found desirable. It can be made as high as 35 or 40 of heating to 1 of grate surface, advantageously—bearing in mind, however, that each addition to the heating surface, by abstracting caloric, reduces the draft, and diminishing the

consumption of coal on the grate per unit of time, diminishes generally, also, the potential, though it increases the economical evaporative result.

Losses of Labor by the Paddle-wheel.—The speed of the vessel being 6·824 knots of 6082¾ feet, the circumference of the centre of reaction of the paddles 67·60 feet, and the number of revolutions of the wheels per minute 12·491, their slip would be as follows:

$6{\cdot}824 \times 6082\frac{3}{4} = 41508{\cdot}12$ speed of vessel, in feet, per hour.
$67{\cdot}6 \times 12{\cdot}491 \times 60 = 50663{\cdot}50$ " centre of reaction of paddle per hour, in feet.
9155·38 slip per hour, in feet.

Or 18·07 per cent.

The loss by the oblique action of the paddles, calculated as the squares of the sines of their angles of incidence on the water, is 12·89 per cent.

The total losses by the paddle-wheel would then be (18·07+12·89) 30·96 per cent.

The following proportions will be found useful in practice:

Square feet of immersed amidships section of vessel to square foot of paddle (taking the area of two paddles only)			8·179 to 1·000
Do.	do.	(taking the area of *all* the immersed paddles)	1·817 "
Do.	do.	cubic foot of space displacement of steam piston	2·400 "
Do.	do.	do. per double stroke of piston per minute	0·192 "

For the Journal of the Franklin Institute.

English Modesty.

Our friends across the Atlantic are in a fair way of carrying off all the honors connected with marine navigation, if we allow them to take that liberty unopposed, and the *cool impudence* of the thing is most surprising; for instance, the following article is published in the *Builder* for October 11th, 1851, No. 454, p. 658, claiming that the machinery of the Collins' line of steamers was not only copied from the Cunard line, but that engineers and hands were imported from the Clyde into New York for the purpose of constructing their machinery, and that this was one of the conditions on which the United States government granted the contract to Mr. Collins.

"*British and American Steamers.*—In your number of the 4th inst. you quoted an extract from an American paper, in which it is stated that improvements made in the steam engine by Americans, have been adopted in building the "last fast" boats of the Cunard line, and that in the "extra fast boats" of the same line now in course of construction, "they are to go the whole figure, and fashion the engines entirely after the most approved American models." By giving currency, as you have done on this and other recent occasions, without comment, to the overweening estimate which the Americans form of their own superiority, you appear to me, Mr. Editor, to do much towards weakening the well-founded confidence which has hitherto been entertained in the perfection of British machinery, thereby injuring British interests, particularly with reference to the demands for engines from foreigners.

It is time, therefore, that the real facts of the case respecting the manufacture of the engines on board Collins' American line of steamers (the vessels more immediately alluded to in the American newspaper) should be made known, which I now do from undoubted authority, and, as regards some of the particulars, from my own knowledge,—and which are as follows:—

The United States Government, perceiving the failure of all the attempts that had been made to establish an American line of Atlantic steamers, which should compete in point of speed and efficiency with the Cunard line, and deeming it of the greatest national importance that this inferiority should no longer continue, subsidized, with a large annual subvention, Collins' line, (besides, it is believed, giving pecuniary aid in some shape or other towards the construction of the vessels,) on condition that no expense should be spared in obtaining the most perfect and efficient engines that could be constructed; and

as there was at that time (although it is only two years ago) no manufacturer in the United States who could make engines fulfilling these conditions, the contractors for the American line turned their views towards the Clyde, and obtained permission from the proprietors of the Cunard line to take mouldings or castings of every part, even to the minutest particular, of the engines constructed by Napier, of Glasgow, on board the largest of their vessels; and in order that nothing might be wanting to make the engines equal to those in the Cunard steamers, the contractors imported men from the manufactories on the Clyde for the purpose of making the engines in New York, so that they might be of national or American fabric.

As, therefore, the last constructed and fastest of the American or ocean-going steamers are made entirely after the British model and by "Britishers," you will perceive, Mr. Editor, how little likely it is that the Cunard vessels now in course of construction are to be fitted with engines made after the American model. Where, indeed, have the Americans anything better to show than the engines on board the Collins' line, which are made after the British model? BRITANNICUS."

There is not *one word* of truth in the above article, so far as it relates to the construction of the machinery of the Collins' steamers, and it has emanated from one who is entirely ignorant of what he is writing about, and in his zeal to protect the credit of the Cunard line for speed, has either ignorantly, or by design, written the article to blind his countrymen as to the truth, for it is *rather* mortifying to be beat by Brother Jonathan on a field that two years since was controlled entirely by Great Britain. Now for a few facts; the machinery for the Atlantic and Arctic was designed and constructed at the Novelty Works, New York, whose engineer, T. B. Stillman, Esq., (the senior member of the firm) is a Yankee from the valley of the Mohawk, and I am quite positive has never visited England, at any rate has not been there for the last five years. The engines for these two ships were designed and constructed under his immediate supervision. The engines for the Pacific and Baltic were constructed at the Allaire Works, and were designed by Charles W. Copeland, Esq., engineer of the works, (another Yankee from Connecticut,) and constructed under his supervision. The chief engineer of the line, John Faron, Esq., was I believe born in Ireland, and came to this country when about two years old, at which time we may fairly infer he had not imbibed many ideas on marine navigation. Mr. F. was superintending engineer on the part of Mr. Collins, and it is understood, designed the boilers of all the vessels.

If the writer in the *Builder* can from the above statement, (which is strictly true,) make out that the engines were copied from the Clyde, and designed and built by English engineers, I should be happy to hear his argument. I can, however, I think, give him a hand to help him out of his dilemma. The engines of the Ohio and Georgia, Chagres and New Orleans steamers, were designed by an engineer from the Clyde, (Mr. Tothill,) and constructed under his supervision at the then works of T. F. Secor & Co., (now Morgan Iron Works,) New York; they are of the same size and have a strong resemblance to the engines of the Cunard steamers Europa and Niagara, but are improved in having balance valves, by which one man can work each engine, instead of requiring three, the usual practice on the Clyde. The boilers are also essentially different from those of the English steamers.

Those who pay any attention to the English papers, must well remember that it was a long time before *they* would admit that the Collins'

line were the equal in speed of the Cunard steamers; but now that they are obliged to admit the truth, and own that they are beaten, they turn round with all the coolness imaginable, and actually call it a triumph of English engineering.

What they have claimed as to the Collins' steamers, they are now asserting in relation to the yacht America. Most persons on this side of the Atlantic have supposed that she was built by William H. Brown, Esq., of New York, and that she was designed by his foreman, Mr. Steers, and that good or bad, she was truly the production of this country; they have also the impression, that while building, drawings were taken of her on the stocks, and published in several of the English papers, and that those papers all spoke of her peculiar form, and not one of them claimed her as being built from an English model; but all this was before the race; no sooner is that over, than several English papers discover a very strong resemblance to some of the fishing boats on their coast; others are more definite, for instance, the *London Mechanics' Magazine*, October number, page 289, says, "It turns out that among other novelties, she had *sliding keels*, and probably this contributed not a little to her triumph. Sliding keels, however, are well known to have been the invention of the late British Admiral Sir John Schank."

Now it is a well known fact, in this country at least, that the use of centre boards or sliding keels, as they are termed in England, dates farther back than the memory of the oldest inhabitant, and at the risk of disturbing the ashes of Sir John Schank, I must say he had nothing to do with their invention in this country; nearly every river sloop in the vicinity of New York, at least as long back as the memory of man goeth, used them, and the date of their invention was as great a mystery then as now. Another English writer says, the America is modelled on the wave principle, and therefore she is an English model, because Mr. John Scott Russell is the inventor of the system; that Mr. Russell has done much to beat a little common sense into the heads of some of the ship builders of England, I allow. He has undoubtedly for years past seen, that while the models of our ships were being constantly improved, yet in England they were all but stationary, and an English merchantman could be readily told from her build, no matter what flag she might carry or how much they might attempt to disguise her. There has not been during the last twenty years a single English regular packet ship trading to this country, their inferiority being universally conceded. Mr. Russell, fully aware of this, has adopted essentially the theory and practice of some of our best builders; that he *thinks* he is original in his ideas, I am willing to admit, for I have watched for years past his efforts, and he may perhaps claim the merit of being the originator so far as his own country is concerned; but when he claims, *as he is now doing*, that we are adopting *his ideas*, it is carrying the joke too far. In the *London Architect* for August, Mr. Russell claims, that his system has been generally adopted in this country; that our present practice and Mr. Russell's may assimilate is quite possible, but ours has been of a gradual native growth, and if it has any merit it belongs to our own ship builders, with whom it originated, and who have gradually carried it forward to its present position of triumph. Mr. Russell states, that the yacht *Titania*, the competitor of the America,

was modelled on his system, which I am glad to know, as the two vessels being essentially different, he cannot then claim the America.

The next move, I suppose, will be to call Com. Stevens, who sailed the America, an Englishman, and then the whole thing will be complete. How contemptible is that spirit that cannot see good in another; for my part, I allow that we have gained much knowledge from an examination of the machinery of the various English steam ships that have visited us, and this kindness we shall fully repay by teaching brother John how to model a ship. B.

For the Journal of the Franklin Institute.

Remarks on J. W. Nystrom's Remarks on the Propeller and Steam Engine of the War Steamer "San Jacinto." By J. V. Merrick.

The readers of this Journal, in perusing various calculations and remarks inserted on former occasions in its pages by Mr. J. W. Nystrom, on the subject of Marine Propulsion, may have been a little surprised at the facility with which sundry disputed points were disposed of, and observed results of experience set at nought, when brought to the *test* of theory, unsupported either by proof or probability. Without desiring in this connexion to quarrel with the positions taken by Mr. N. in his former articles, I feel too much interest in the subject of his last one, (in the Dec. No., pp. 402-404,) to forbear venturing a word or two regarding some remarks he has therein seen fit to make on a Report of the recent trial trip of the U. S. steamer San Jacinto; in the course of which remarks we are gravely informed that the "slip" is falsely reported, because it does not correspond with the result of an empirical formula, and with his opinion of what *ought to be* the slip under the circumstances. Happening to know some of the facts of this case, I can inform Mr. Nystrom that not only is the slip of the San Jacinto correctly reported by Mr. Isherwood, (that is, if any reliance is to be placed on the Charts of the U. S. Coast Survey, and the observed time, compared by several competent and disinterested individuals,) but that furthermore, other instances might be adduced to show that 26¼ per cent. slip is not remarkable, as being either very small or very great, in a vessel of her resistance and propelling area; but is simply about what might be predicted, by those who predicate their judgment on former experience. It may also be observed that, so far from anticipating a passage from Liverpool to Halifax in 5·78 days, because her propeller has a slip of only 26¼ per cent. in still water, it is much more likely that the San Jacinto will not accomplish it in less than ten days. To appreciate the force of Mr. N.'s argument, it is merely necessary to suggest, 1st, that heavy weather at sea, or even a very slight swell, is, unfortunately, apt to increase the slip of all propelling agents; and, 2d, although Mr. N. announces that "there would be no difficulty in giving the propeller 50 revolutions per minute," it is almost certain that not even 31 revolutions (the number on the trial) will ever be attained at sea, when the ship has her full supply of coals, provisions, and stores, and where the water is rarely at rest. It would be easy by such a mode of calculation, to argue a six days' passage as possible for the Col-

lins' steamers; because if there is "no difficulty" in giving their paddle wheels an increased number of revolutions in the ratio of 31 to 50: then, as the Pacific has already accomplished the trip in 9 days 20 hours, she of course can do it in $\frac{9{\cdot}83 \times 31}{50} = 6{\cdot}1$ days. It is scarcely necessary to say that the difficulty in the way of speed exists precisely in this point; the number of revolutions can *not* be increased ad libitum.

But there is another remark which calls for notice. Mr. N., to demonstrate that slip is not loss of effect, says, after calculating what would be the vessel's speed if there were no slip, that, "as there is no slip in the water, the propeller is of no use for propelling the vessel; it can as well be taken off, and the remainder will be 375·92 horse power from the *steam engine, which will drive the vessel* 15 *miles an hour with no propeller !!!*"

Admitting the principle involved in this declaration, it is equally clear that wheels are entirely unnecessary to the functions of a locomotive engine, because in that case there is no slip, and consequently the wheels may be taken off, and the remainder will be the whole effective power of the engine, which will drive the locomotive at — miles per hour, *without wheels.*

Is it necessary to remind Mr. N., that "slip" is nothing more than recession of the fulcrum against which the paddle or propeller blade acts? and that therefore the loss involved in it, is a loss of space passed over in a given time; hence a loss of velocity; and therefore that it is what is commonly called "loss of effect," or more correctly speaking, loss of useful effect.

This article has already so far transcended the limits within which I had proposed to retain it, that for the demonstration of the above stated principle, I must appeal to the reflection of Mr. Nystrom, and of those (if any) who, persuaded by his denial, may have allowed themselves for a moment to doubt the truth of a theory so well established.

For the Journal of the Franklin Institute.

Practical Rule for finding the Thickness of Cast Iron Water Pipes. By John C. Trautwine, *Civ. Eng.*

Books afford to practical men no guide by which to determine the thickness of cast iron pipes for resisting the pressures of different heads of water. Most authors who allude to the subject, content themselves with merely giving theoretical rules, which are well known to furnish results entirely too low for use in practice.

Thus, Barlow's Rule gives, for a 16-inch pipe to support a head of 100 feet, a thickness of but $\frac{1}{100}$th part of an inch, or about twice that of a sheet of ordinary letter paper.

Other writers, again, give the results of some very incomplete experiments, altogether too limited in number to serve as general data; while others either pass over the subject in silence, or at most, with an intimation that it admits of no specific instructions.

The fact that the theoretical thicknesses are so entirely insufficient for

practice, appears to have deterred scientific men from a more thorough investigation of the cause; and practical ones have, in consequence, been compelled to adopt such limited results of experience as they could chance to obtain, taking care generally to err on the safe side. In some instances, this precaution has been attended with useless expenditures of heavy sums of money.

The principles involved in the investigation of this subject, although presenting difficulties to a scientific solution, admit, as I conceive, of a simple and sufficiently satisfactory one in practice.

Mr. Barlow, in giving his Rule, (see the Transactions of the Institution of Civil Engineers,) assumed the *safe* cohesive strength of cast iron at 18,000 pounds per square inch; but Hodgkinson has since conclusively shown by numerous experiments, that it is not safe to employ more than 15,000 pounds per square inch as the *ultimate* cohesive strength of ordinary cast iron. This being the case, I have assumed 5000 pounds per square inch as the *safe* limit for water pipes, abstractedly considered; and modifying Barlow's Rule in this particular only, have prepared the following table. But it will be evident to any one practically conversant with the subject, that even the thicknesses given by the table are not sufficiently great for actual use, and the question arises, why are they not so? The answer appears to be simply this—that in the smaller pipes a greater thickness is necessary to ensure safety from breaking while being transported, handled, and laid; and that, in both small and large ones, it is extremely difficult to cast them of the proper lengths, and at the same time of an *uniform thickness*, and without more or less imperfection from air bubbles, &c. Consequently an excess becomes necessary, in order to counteract these sources of weakness. Moreover, after the pipes are laid, the soil below them may settle unequally, and a greater or less length of pipe may thus become a kind of tubular girder, sustaining the mass of earth which rests upon its upper side.

From a careful examination of a great number of instances collected from various sources, I conceive that I am warranted in asserting that the additional thickness required to guard against irregularities in the casting, will at the same time suffice for security in handling, and for as great a resistance to fracture, from unequal settlement, as we shall find it expedient to aim at in ordinary practice. Any attempt to obviate the last difficulty *entirely*, would in many cases be attended with an expense so great as to restrict the use of water pipes within very narrow limits. It is generally advisable, therefore, not to make the attempt, but to submit to the *comparatively* trifling inconvenience of those occasional fractures which almost invariably attend the execution of extensive systems of water pipes.

Water pipes of the usual length of about 9 feet, cannot well be cast of a less thickness than $\frac{3}{8}$-in., and in very large pipes, $\frac{5}{8}$-in. is not too great an excess over the calculated thickness, to allow for irregularities and defects in the castings. Therefore, I will venture to offer the following as a practical rule for the thickness of cast iron pipes, to sustain safely different heads of water under ordinary circumstances, viz:

To the thicknesses given in the following table, add $\frac{3}{8}$-in. for all pipes under 12 inches diameter; $\frac{1}{2}$-in. for those of from 12 to 30 inches; and $\frac{5}{8}$-in.

for those of from 30 *to* 48 *inches diameter. Or, if it should be considered expedient to allow something for* rusting, *add respectively,* $\frac{1}{2}$, $\frac{5}{8}$, *and* $\frac{3}{4}$*-in., instead of* $\frac{3}{8}$, $\frac{1}{2}$, *and* $\frac{5}{8}$*-in.*

Inner diameter or bore of Pipe in inches.	HEAD OF WATER IN FEET.															
	100	150	200	250	300	400	500	600	800	1000	1200	1400	1600	2000	2500	3000
	Pressure of Water against sides of Pipe, in pounds per square inch.															
	43·4	65·1	87	109	130	174	217	260	347	434	521	608	694	868	1085	1302
	Thickness of Pipe in inches.															
2	·009	·013	·018	·022	·027	·036	·045	·055	·075	·095	·116	·139	·161	·210	·277	·352
3	·013	·020	·026	·033	·040	·054	·068	·082	·112	·143	·173	·207	·242	·315	·417	·530
4	·017	·026	·035	·045	·053	·072	·090	·110	·149	·191	·232	·278	·322	·420	·555	·704
5	·022	·033	·044	·056	·067	·090	·113	·137	·186	·237	·290	·347	·402	·525	·695	·880
6	·026	·040	·053	·067	·080	·108	·136	·165	·224	·287	·347	·415	·485	·630	·835	1·06
7	·030	·046	·062	·078	·093	·126	·159	·193	·261	·333	·406	·485	·565	·735	·970	1·23
8	·034	·053	·071	·089	·107	·144	·181	·220	·298	·382	·465	·556	·644	·840	1·11	1·41
9	·039	·059	·079	·101	·120	·163	·205	·247	·335	·427	·520	·622	·724	·945	1·25	1·58
10	·044	·066	·089	·112	·134	·181	·227	·275	·373	·475	·580	·695	·805	1·05	1·39	1·76
12	·053	·080	·106	·134	·161	·217	·273	·330	·448	·575	·695	·830	·970	1·26	1·67	2·12
14	·061	·093	·124	·156	·187	·253	·318	·387	·523	·666	·813	·970	1·13	1·47	1·94	2·47
16	·069	·106	·142	·178	·214	·288	·363	·440	·596	·763	·930	1·11	1·29	1·68	2·22	2·82
18	·078	·120	·159	·201	·242	·326	·409	·495	·670	·850	1·04	1·24	1·45	1·89	2·50	3·18
20	·088	·132	·177	·223	·267	·361	·454	·549	·746	·950	1·16	1·39	1·61	2·10	2·77	3·52
24	·105	·159	·213	·268	·321	·433	·545	·660	·895	1·15	1·39	1·66	1·94	2·52	3·33	4·23
30	·132	·198	·267	·336	·402	·543	·681	·825	1·12	1·42	1·74	2·08	2·41	3·15	4·17	5·28
36	·156	·238	·318	·402	·483	·651	·819	·990	1·34	1·71	2·08	2·49	2·91	3·78	5·01	6·36
42	·184	·279	·372	·469	·562	·759	·955	1·16	1·57	2·00	2·44	2·91	3·39	4·41	5·83	7·42
48	·210	·317	·425	·535	·641	·866	1·09	1·32	1·79	2·29	2·79	3·32	3·87	5·04	6·65	8·45

Barlow's Rule.—Multiply the pressure against the inner diameter of the pipe in pounds per square inch, by half the inner diameter in inches, and divide the product by the difference between the cohesion of the metal per square inch, (assumed in the above table at 5000 lbs.,) and the pressure in pounds per square inch. The quotient will be the required thickness in inches.

Seasoning Timber. By Samuel Clegg, Jr.*

Seasoning timber is the extraction of all the vegetable juices and moisture from the woody fibre, leaving it perfectly dry and free from the effects of that unequal expansion and contraction of moisture between the fibres which causes timber to warp, twist, and crack. Seasoning is effected by natural and artificial means.

Timber loses both in dimensions and weight by seasoning, as shown in the following table of experiments, instituted in order to ascertain the weight of a cubic foot of different kinds of wood,—the foreign when first imported, those of the growth of England when felled, also the weight of each when fully seasoned, showing at the same time *the loss sustained in dimensions during the process of seasoning.*

* From the London Architect, for September. 1851.

Table of Experiments by Mr. Benjamin Couch, *of Plymouth Dockyard.*

Species (in the language of commerce.)	Country where produced.	What part of the tree the pieces experimented on were cut from.	Dimens'ns when first planed		Dimensions when seasoned.		Weight in air of a cubic foot in ounces avoirdupois.	
			Length.	Breadth and thickness, or diameter.	Length.	Breadth and thickness, or diameter.	When first planed.	When seasoned.
			Ft. In.	Inches.	Ft. In.	Inches.	oz.	oz.
Riga masts, supe'or	Russia	Butt*	7 6	18 diameter.	7 6	$17\frac{3}{4}$ diameter.	672	644
		Top	4 5	11 × 11	4 5	$10\frac{13}{16} \times 10\frac{3}{4}$	546	552†
Riga masts, infe'or	Ditto	Butt	12 0	12 diameter.	12 0	$11\frac{7}{8}$ diameter.	577	494
		Top	6 6	$8\frac{3}{4}$ diameter.	6 6	$8\frac{1}{2}$ diameter.	464	464
Pitch pine mast	Baltimore, N. America	Butt	2 6	10 × 10	2 6	$9\frac{3}{4} \times 9\frac{3}{4}$	755	741
		Top	6 0	$7\frac{1}{2} \times 7\frac{1}{2}$	6 0	$7\frac{3}{8} \times 7\frac{3}{8}$	518	524
Yellow pine mast	Canada	Butt	2 4	18 × 18	2 4	$17\frac{7}{8} \times 17\frac{7}{8}$	683	461
		Top	5 0	16 × 16	5 0	$15\frac{7}{8} \times 15\frac{7}{8}$	495	420
White pine mast	New Brunswick .	Butt	3 11	12 × 12	3 11	$11\frac{15}{16} \times 11\frac{7}{8}$	679	436
		Top	3 11	8 × 9	3 11	$7\frac{15}{16} \times 8\frac{15}{16}$	411	368
Red pine mast	Canada	Butt	2 0	12 × 12	2 0	$11\frac{3}{4} \times 11\frac{3}{4}$	672	569
		Top	14 0	11 × 9	14 0	$10\frac{5}{8} \times 8\frac{3}{4}$	570	503
Oak	England	Butt	1 10	$12 \times 11\frac{3}{4}$	1 10	$11\frac{5}{8} \times 11\frac{3}{8}$	1113	*743
		Top	2 0	$6\frac{1}{2} \times 6$	2 0	$6\frac{3}{16} \times 5\frac{3}{4}$	1071	777
Elm	Ditto	Uncertain.	4 0	11 × 11	4 0	$10\frac{3}{4} \times 10\frac{3}{4}$	940	588

* The butts and tops were cut from the same tree.

† Should it be asked, why a cubic foot of some of the pieces increases in weight in *seasoning?* the reason is, that they lost more in dimensions than in weight during that process.

For further information, see Barlow "On the Strength of Materials."

It will be perceived that in *length* no variation takes place, but in width the shrinkage is considerable; therefore it is that joints in floors, &c., laid with unseasoned timber, open, notwithstanding they may have been left quite close by the workman.

Natural seasoning is effected by removing the timber from where it has been felled as soon as possible, (the sooner the better,) and placing it in an inclined position in a dry situation, where the air may circulate freely round it; but it should not be exposed either to the sun or wind, as the unequal action caused by either would give the timber a tendency to split, by irregular drying. The lower edge of the timber should not touch the ground; and if there is more than one piece they must have air space between them. If timber can be kept for some time in a dry situation before it is cut into scantlings, it is less subject to warp and twist in drying. Lately, in some of the government yards, the timber has been laid upon cast iron bearers, instead of being laid upon refuse pieces of wood, as the refuse wood may be half rotten, and then must, in some degree, contribute to infect the sound timber. Timber, when converted into scantlings, still requires attention, even though the log from which it was cut was seasoned. It should be piled in a sloping direction, with space for air all round each piece. A drying yard should be well drained, and on no account should pools of water be allowed to stand on it. For the general purposes of the engineer, timber should be in seasoning two years before use. For joiner's work, Mr. Tredgold says four years should elapse, unless other methods than natural seasoning be resorted to.

Immersion in water has been said to facilitate the process of seasoning. Newly-cut timber placed some twelve or fourteen days entirely under water and then dried in the sun and wind, is rendered less liable to warp and crack; but it loses somewhat in strength. *Partial* immersion is destructive to timber. The theory of water-seasoning seems to be, that sap being soluble, its fermentable properties are lessened by dilution.

Seasoning timber by steaming or boiling is dangerous, for hot water, or steam, has to some extent the power of dissolving the woody fibre. Mr. Barlow says: "Although there is an obvious falling off in the strength of timber boiled for a long time, the defect is very small while the boiling or steaming is not continued beyond the proportion of an hour to an inch in thickness, which is the usual practice in the dockyards."

Davison's desiccating process for drying and seasoning timber will be found explained in the *Civil Engineer and Architects' Journal*, Vol. XII., p. 310. Heating timber in a chamber furnished with flues facilitates the evaporation of the watery particles; but heat is not the only essential required for drying—a current is likewise necessary; otherwise all the water which is thus converted into vapor will only tend to charge the chamber with steam, and it is not until this steam has arrived at a certain pressure, that it will make its escape, and the operation of drying commences. It is not only a moving, but a *rapid*, current which is the great desideratum for all drying purposes; and it is the impulsion of atmospheric air through the chamber at any required velocity, by means of a fan combined with heat under perfect control, which constitutes the desiccating process. The greener the wood the easier and more perfect is the expulsion of moisture; and at the same time, the native strength of the fibre is secured

by the immediate evaporation of all vegetable juices and moisture likely to ferment and carry on decomposition. The gums, instead of being removed, are coagulated and hardened, and the texture of the wood generally is less liable to decay. Shrinkage is said to be entirely obviated. The cost of desiccating does not exceed the interest of money sunk in laying up wood to season in the ordinary way. Timber seasoned by desiccation has its strength increased; and compared with that seasoned in the ordinary way, yellow pine is said to be increased in strength 17·6 per cent., Riga fir 20·4, and oak 14·0 per cent.

In reference to impregnating timber with any substance to preserve it from decay, that which has been completely exhausted of aqueous particles by the desiccating process is in the best possible condition to receive such substances; but more especially if timber, instead of being allowed to cool after it is removed from the desiccating chamber, is immediately plunged into a cold antiseptic.

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*Unequal Refraction.**

On Sunday, the 14th of September, there occurred in this neighborhood—five or six miles north-east from Harwick, N. B.—a striking example of unequal refraction. At about a quarter past five in the morning, the figure of a man was seen, quite distinctly, walking in the air, at a very considerable elevation above the ground. A man and a boy walking together first noticed the appearance; and in about ten minutes after they had seen it, pointed it out to a third person.

The representation is described as being that of an old man, dressed in dark-colored clothes and an old-fashioned broad bonnet, with a walking-stick in his hand; and, when first seen, appearing to be about half a mile distant, and magnified to eight or ten feet in height. The figure was so distinct, that the nose and other features were seen; and every motion made in walking—such as the flapping of the coat-tails, the handling of the stick, stooping as if to pick up something from the ground, taking off the bonnet and wiping the forehead—was as plainly exposed as if performed by a man walking on *terra firma*, and at the same apparent distance. When first seen, the object was nearly due east, elevated at about an angle of twenty degrees, and exposed against the clear morning sky—lit up, as it was, by the rays of the approaching sun.

The observers occupied a position of very considerable altitude, and which affords an uninterrupted view across the country for fifteen or twenty miles, when it is closed by Cheviot Mountain, which lay directly in range of the object, though far below it. The course pursued by the aerial walker was north-easterly and descending; so that, at one time, he gradually disappeared altogether, the head and shoulders remaining in view some time after the lower parts had vanished. After the spectators had walked on about a mile farther, however, their course lying north-north-west, the phenomenon again became distinctly visible; and as they had been ascending, so it appeared correspondingly higher above the horizon. It was then followed by a dog, which, however, from dis-

* From the London Athenæum, September, 1851.

tortion or some other cause, could scarcely be distinguished from a sheep, only its ears appeared larger and more erect.

All this time there never appeared any ground along with the figure, which stalked with long leisurely strides athwart the clear sky; and when last seen, and when it had descended nearer to the horizon, became tinged of a lurid red by the rays of the sun, and appeared cut in two by a stripe of red cloud. From first to last, the spectacle was seen for about the space of half an hour; and when in view the second time, it appeared to be much farther off than at first—perhaps about two miles distant—though, strange to say, still distinctly and minutely visible. There would appear to have been some optical illusion or misconception as to the distance of the object; and nothing, as yet, is known of its corporeal representative.

For the Journal of the Franklin Institute.

A Series of Lectures on the Telegraph, delivered before the Franklin Institute. Session, 1850–51. *By* Dr. L. Turnbull.

Continued from Vol. xxii, page 415.

Printing Telegraph of Alfred Vail.

The printing telegraph of Alfred Vail was proposed in September, 1837. It consists of a type wheel having on its surface the twenty-four letters of the alphabet. On the side of the wheel are twenty-four holes. The type wheel is moved circularly by means of a spring that the electro-magnetic key causes to advance at each interruption and return of the current. The paper advances under the type wheel by means of an independent clock movement.

The precision of the operation depends on the exact correspondence of the machinery, situated at the two extremities of the telegraphic lines. It is necessary that the type wheel presents the same letter at both stations, and that the clock moves at the same rate. But I believe that this system has never been put in execution. I copy from p. 169 of his work on the telegraph, the conclusions he comes to in regard to this form of telegraph:

"All electro-magnetic telegraphs require as their basis, the adoption of the *electro-magnet*, when recording the intelligence is an object, and it would seem, must be applied in a manner equivalent to the mode adopted by Prof. Morse; that is, the application of the armature to a lever, and its single movement produced by closing and breaking the circuit. It is, therefore, safe to assume that, whatever improvement in one plan may be made to increase the rapidity of the movements of those parts of the telegraph which belong to the electro-magnet, is equally applicable to any other plan, provided too much complication, already existing, does not counteract and defeat the improvement.

"Some plans, however, use an extra agent besides the electro-magnet, which is employed for measuring the time of the revolution of the type wheel, and the electro-magnet is only called in, occasionally, to make the impression. In such plans the rapidity of communication demands the

combined action, alternately, of both magnets. This, of course, increases the complication, and must certainly be considered a departure from other more simple arrangements. Whatever will reduce the inertia of mechanical movements and bring them to act with an approximate velocity, at least of the fluid itself, will increase the rapidity of transmission. The more the instrument is encumbered with the sluggish movements of material bodies, the less rapid, inevitably, must be its operation, even where several co-operating agents are assisting, in their respective spheres, to increase the rapidity of the motion. Such is the case with the several kinds of letter printing telegraphs: very weighty bodies, comparatively speaking, are set in motion, stopped, again set in motion, and along with this irregular motion, other parts perform their functions. There must be a courtesy observed among themselves, or matters do not move on as harmoniously as could be desired. This is not always the case, especially where time is the great question at issue.

"All printing telegraphs which use type, arranged upon the periphery of a wheel, must have, of necessity, these several movements, viz: the irregular revolution of the type wheel, stopping and starting at every division or letter; the movement of the machinery, called the printer; the irregular movement of the paper, at intervals, to accommodate itself to the letter to be printed; the movement of the inking apparatus, or what is not an improvement in cleanliness, paper of the character used by the manifold letter writer. So many moving parts, are so many impeding causes to increased rapidity, and are, to all intents and purposes, a *complication.*

"The requirements of a perfect instrument are: economy of construction, simplicity of arrangement, and mechanical movements, and rapidity of transmission. To use one wire is to reduce it to the lowest possible economy. If there is but one movement, and that has all the advantages which accuracy of construction, simplicity of arrangement and lightness, can bestow upon it, we might justly infer that it appeared reduced to its simplest form.

"The instrument employed by Prof. Morse has but a single movement, and that motion of a vibratory character; is light and susceptible of the most delicate structure, by which rapidity is insured; the paper is continuous in its movement, and requires no aid from the magnet to carry it.

"The only object that can be obtained by using the English letters, instead of the telegraphic letters, is, that the one is in common use, the other is not. The one is as easily read as the other; the advantage then is fanciful, and is only to be indulged in at the expense of time, and complication of machinery, increasing the expense, and producing their inevitable accompaniments, liability of derangement, care of attendance, and loss of time."

Alexander's Electric Telegraph.

I copy this account of Alexander's telegraph from the *London Mechanics' Magazine*, of November, 1837, but it was copied originally from the *Scotsman*, a paper published in Edinburgh, perhaps a month before, and a model to illustrate the nature and the operation of the telegraphic

machine, was exhibited at a meeting of the Society of Arts in Edinburgh, in October, 1837.

The model consists of a wooden chest, about five feet long, three feet wide, three feet deep at the one end, and one foot at the other. The width and depth in this model are, those which would probably be found suitable in a working machine; but it will be understood that the length in the machine may be a hundred or a thousand miles, and is limited to five feet in the model, merely for convenience. Thirty copper wires extend from end to end of the chest, and are kept apart from each other. At one end, (which for distinction's sake, we shall call the south end,) they are fastened to a horizontal line of wooden keys, precisely similar to those of a piano-forte; at the other, or north end, they terminate close to thirty small apertures equally distributed in six rows of five each, over a screen of three feet square, which forms the end of the chest. Under these apertures on the outside, are painted in black paint upon a white ground, the twenty-six letters of the alphabet, with the necessary points, the colon, semicolon, and full point, and an asterisk to denote the termination of a word. The letters occupy spaces about an inch square. The wooden keys at the other end have also the letters of the alphabet painted on them in the usual order. The wires serve merely for communication, and we shall now describe the apparatus by which they work. This consists, at the south end, of a pair of plates, zinc and copper, forming a galvanic trough, placed under the keys; and at the north end of thirty steel magnets, about four inches long, placed close behind the letters painted on the screen. The magnets move horizontally on axes, and are poised within a flat ring of copper wire, formed of the ends of the communicating wires. On their north ends they carry small square bits of black paper, which project in front of the screen, and serve as opercula or covers to conceal the letters. When any wire is put in communication with the trough at the south end, the galvanic influence is instantly transmitted to the north end; and in accordance with a well known law discovered by Œrsted, the magnet at the end of that wire instantly turns round to the right or left, bearing with it the operculum of black paper, and unveiling a letter. When the key A, for instance, is pressed down with the finger at the south end, the wire attached to it is immediately put in communication with the trough; and the same instant the letter A at the north end is unveiled by the magnet turning to the right, and withdrawing the operculum. When the finger is removed from the key, it springs back to its place, the communication with the trough ceases, the magnet resumes its position, and the letter is again covered.

Thus, by pressing down with the finger, in succession, the keys corresponding to any word or name, we have the letters forming that word or name exhibited at the other end; the name, *Victoria* for instance, which was the maiden effort of the telegraph on Wednesday evening. In the same way we may transmit a communication of any length, using an asterisk or cross, to mark the division of one word from another, and the comma, semicolon, or full point, to make a break in a sentence, or its close. No proper experiment was made while we were present to determine the time necessary for this species of communication, but we have reason to believe, that the letters might be exhibited almost as rapidly

as a compositor could set them up in type. Even one-half or one-third of this speed, however, would answer perfectly well.

Galvanism, it is well known, requires a complete circuit for its operation. You must not only carry a wire to the place you mean to communicate with, but you must bring it back again to the trough. (The writer of this communication, and even Mr. Alexander, was not aware of the discovery of Steinheil, that the earth would conduct so as to return the current without the use of the second wire.—L. T.) Aware of this, our first impression was, that each letter and mark would require two wires, and the machine in these circumstances having sixty wires instead of thirty, its bulk and the complication of its parts would have been much increased. This difficulty has been obviated, however, by a simple and happy contrivance. Instead of the return wires, extending from the magnet back to the keys, they are cut short at the distance of three inches from the magnet, and all form a transverse copper rod, from which a single wire passes back to the trough, and serves for the whole letters. The telegraph, in this way, requires only thirty-one wires. We may also mention, that the communication between the keys and the trough is made by a long narrow basin filled with mercury, into which the end of the wire is plunged when the key is pressed down with the finger.

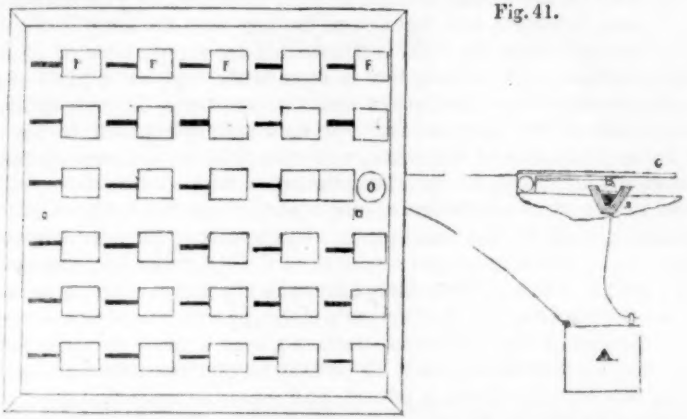
The telegraph thus constructed, operates with ease and accuracy, as many gentlemen can witness. The term model, which we have employed, is, in some respects, a misnomer. It is the actual machine, with all its essential parts, and merely circumscribed as to length by the necessity of keeping it in a room of limited dimensions. While many are laying claim to the invention, to Mr. Alexander belongs the honor of first following out the principle into all its details, meeting every difficulty, completing a definite plan, and showing it in operation. About twenty gentlemen, including some of the most eminent men of science in Edinburgh, have subscribed a memorial, stating their high opinion of the merits of the invention, and expressing their readiness to act as a committee for conducting experiments upon a greater scale, in order fully to test its practicability. This ought to be a public concern; a machine which would repeat in Edinburgh, words spoken in London, three or four minutes after they were uttered, and continue the communication for any length of time, by night or by day, and with the rapidity which has been described; such a machine reveals a new power, whose stupendous effects upon society no effort of the most vigorous imagination can anticipate.

The principle of Alexander's telegraph is represented in the following illustration from the work of Alexander Bain, Esq., fig 41. It consists of but one circuit, so as to make the operation intelligible.

A is a voltaic battery; B, a trough filled with mercury; C, a key to be pressed down by the finger of the operator; *e*, is the end of a conducting wire, which dips into the mercury when the key is depressed, and completes the electric circuit; D D, is the distant dial upon which the signals are to be shown; F F, are screens, thirty in number, each being fixed to a needle, corresponding to the finger keys before described. When no electricity is passing, these screens remain stationary over the several letters, &c., and conceal them from view; but when a current is made to flow, by the depression of a key, the corresponding needle, in

the distant instrument, is deflected, carrying the screen with it, and uncovering the letter, which becomes exposed to view, as at O.

Fig. 41.



In the same Magazine, there is an improvement suggested by a correspondent, which is obvious and a good one, namely, the use of fifteen wires to represent two letters, thus: let each of the letter screens affixed to the movable magnets be wide enough to cover two letters. Then the positive end of the galvanic battery being connected with the inducing wire, by a touch of the keys, the magnet and screen will move in one direction and discover one letter. The negative end of the battery being thus connected with the same wire, the magnet will move in the contrary direction, and discover the other letter. There must, of course, be something fixed to prevent the magnet going so far in either direction as to discover both letters. The returning wire connected with all the other thirty, must of course have its connexion with the battery poles reversed, at the same time as the lettered wire. To prevent oscillation, let each wire act upon two magnets and screens, one magnet and screen moving in one direction, but prevented from moving in the other as now. The current of electricity if reversed, would, on account of this prevention, not move this magnet and screen in the opposite direction, but it might the other magnet and screen having a similar stop or prevention, but placed on the other side of the pole.

Davy's Needle and Lamp Telegraph.

This telegraph is called the needle and lamp telegraph, to distinguish it from the telegraph of Edward Day, which I will describe in a future lecture.

"There is a case, which may serve as a desk to use in writing down the intelligence conveyed; and in this, there is an aperture about sixteen inches long, and three or four wide, facing the eyes, perfectly dark. On this the signals appear as luminous letters, or combinations of letters, with a neatness and rapidity almost magical. The field of view is so confined, that the signals can be easily caught and copied down without the necessity even of turning the head. Attention, in the first instance, is called by three strokes on a little bell; the termination of each word is indica-

ted by a single stroke. There is not the slightest difficulty in decyphering what is intended to be communicated.

"In front of the oblong trough, or box, described by your correspondent, a lamp is placed, and that side of the box next the lamp is of ground glass, through which the light is transmitted for the purpose of illuminating the letters. The oblong box is open at the top, but a plate of glass is interposed between the letters and the spectator, through which the latter reads off the letters as they are successively exposed to his view. At the opposite side of the room, a small key board is placed, (similar to that of a piano forte, but smaller,) furnished with twelve keys; eight of these have each three letters of the alphabet on their upper surfaces, marked A, B, C; D, E, F; and so on. By depressing these keys in various ways, the signals or letters are produced at the opposite desk, as previously described; how this is effected is not described by the inventor, as he *intimated* that the construction of certain parts of the apparatus *must remain* SECRET.

By the side of the key board, there is placed a small galvanic battery, from which proceeds the wire, 25 yards in length, passing round the room. Along this wire the shock is passed, and operates upon that part of the apparatus which discloses the letters or signal. The shock is distributed as follows: The underside of the signal keys are each furnished with a small projecting piece of wire, which, on depressing the keys, is made to enter a small vessel, filled with mercury, placed under the outer ends of the row of keys; a shock is instantly communicated along the wire, and a letter, or signal, is as instantly disclosed in the oblong box. By attentively looking at the effect produced, it appeared as if a dark slide were withdrawn, thereby disclosing the illuminated letter. A slight vibration of the (apparent) slide, occasionally obscuring the letter, indicated a great delicacy of action in this part of the contrivance, and although not distinctly pointed out by the inventor, is to be accounted for in the following manner: when the two ends of the wire of the galvanic apparatus are brought together, over a compass needle, the position of the needle is immediately turned, at right angles, to its former position; and again, if the needle is placed with the north point southward, and the ends of the wire again brought over it, the needle is again forced round to a position at right angles to its original one. Thus, it would appear, that the slide or cover over the letters, is poised similarly to the common needle, and that by the depression of the keys, a shock is given in such a way as to cause a motion from right to left, and *vice versa*, disclosing those letters, immediately, under the needle so operated upon."—*London Mech. Mag. Vol.* xxviii., 1837.

Masson Magneto-Electric Telegraph.

In 1837, Prof. Masson, of Caen, addressed a letter to the French Academy, in which he announced that he had made several trials with a magneto-electric telegraph, for the distance of 1800 feet. He employed for the development of the current, the magneto-electric machine of Pixü, to produce the deflexion of magnetic needles placed at the extremities of the circuits. These trials were repeated in October, 1838, with Bréquet, who was at that time one of the members of the Commission on the Telegraph from Paris to Rouen, but the results obtained were not as satisfactory as those of Steinheil, Morse, and others; afterwards Mas-

son and Bréquet associated themselves together, and invented a new form of telegraph, a description of which is not given.—*Moigno Traité de Telegraphie, p.* 30.

Amyot's Telegraph.

In a letter addressed to the Academy of Science of Paris, in July, 1838, Amyot proposed the construction of a needle telegraph. It was to consist of a single circuit, which would move a single needle, which needle was to write on paper, with mathematical precision; the correspondence which was to be transmitted to the other extremity, by a simple wheel, on which it should be written by means of points differently spaced, the same as they are on the barrels of portable organs, the wheels to be regulated by clock work.—*Moigno, p.* 31.

To be Continued.

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*Experiments on Cement at the Great Exhibition.**

Some interesting and important experiments on the strength of cements, &c., were made on the 20th, 22d, and 23d inst., at the Great Exhibition, under the supervision of the jury of Class XXVII., when the large beam of hollow bricks and Portland cement, erected in the area at the west end of the building by Messrs. J. B. White & Sons, of Millbank, was broken down. The experiments were watched with great interest by a large number of scientific men and others. Confining ourselves for the present to the works of the firm we have named, we will record some of the experiments which preceded the attack on the beam. The weights used were iron pigs, averaging 100 lbs. each.

The first experiment was on a block of neat Portland cement 4 inches square, suspended at each end, and 16 inches long between the bearings. The weight was applied exactly in the centre. This was broken down by 1580 lbs., including the weight of the scale: the fracture was perpendicular. The block was four months old.

2. A block of neat Roman cement (Harwich stone), exactly the same size as the last, seven months old, broke down with 380 lbs. This must have been defective, and we may say, as applying throughout, that single experiments on the strength of materials must never be trusted to for general deductions, the most extraordinary variations being often found in specimens prepared under, what may be considered, precisely the same circumstances.

3. A block of neat Sheppy cement, the same size as the last, broke with 980 lbs. in the scale.

4. A block of neat Portland cement, six months old, 2 inches thick, and $2\frac{3}{4}$ inches wide, required 2280 lbs. to pull it asunder.

5. Two pieces of Portland stone, 6 inches square (each 6 inches high too,) cemented together by a thin joint of neat Portland cement (four months old,) were suspended. When 3700 lbs. were in the scale attached to the lower stone, the top stone yielded where the iron clippers held it. Afterwards the square holes for the ends of the clippers were made deeper in another part of the stone, and 4500 lbs. were put into the scale, when the iron hook broke, the joint remaining sound.

*From the London Builder, No. 451.

The materials here use being Portland *stone* and Portland cement, it was with difficulty that some of the foreigners present could be made to understand that the latter was not made from the former, and we mention the circumstance as an illustration of the erroneous impressions given by improper appellations. It is the same with Roman cement. A scientific French writer in describing that marvellous piece of construction, the Thames Tunnel, deceived by the name, says that the engineer succeeded here by adopting *the cement of the ancient Romans*, although, as we know very well, the cement in question which really was used had no more to do with the Romans than it had with the Pope.

6. Two pieces of Portland stone, the same size as the last, joined together with Roman cement, five months ago (a thicker joint, by the way, than in the previous case,) required 2780 lbs. (including scale) to separate them,—a much greater weight than was anticipated. The cement left the stone; so that its adhesive power yielded, not its cohesive.

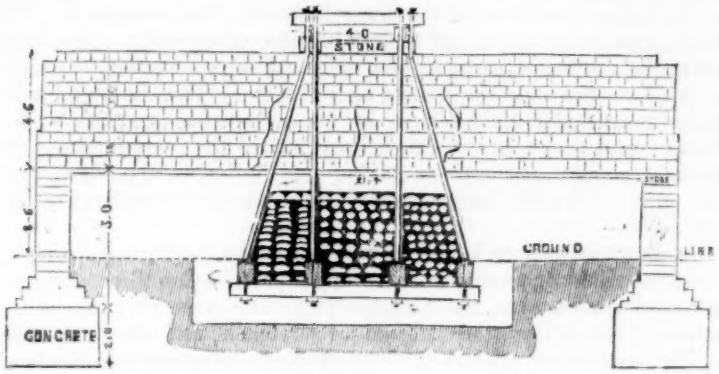
Turning now to the principal example of the series—the hollow brick beam—we annex views of the front and end of it, showing its dimensions and construction, and the mode of applying the weight.

During Saturday the beam was loaded in the central part with 15,000 lbs. weight of pig iron, and in this state it was left until one o'clock on Monday, when it was carefully examined and found quite free from any indication of failure. The loading was then resumed until it was weighted with 40,000 lbs., at which time a deflexion of nearly one-eighth of an inch was observed: with 41,600 lbs. two cracks exhibited themselves in the four lower courses, at a short distance right and left of the centre of the beam, and a crack in the centre of the beam. With 51,600 the cracks extended through the six lower courses and the deflexion increased to five-sixteenths of an inch; with 62,800 lbs., which it bore for a short time, the beam gradually separated into two parts as nearly equal as possible, the line of fracture being vertical and indiscriminately through bricks and joints as they occurred. In falling, the beam thrust the piers considerably out of an upright.

It will be remembered by many that in 1837 an experimental brick beam was (at the suggestion of Mr. Brunel) built by Messrs. Francis and White, at their cement works, Nine Elms, Vauxhall, for the purpose of ascertaining the strength of Roman cement. The beam consisted of hard stock bricks, bonded in the usual way, and bedded and grouted with a mixture in equal portions of the best Roman cement and clean Thames sand, making it completely hollow throughout. It consisted of nineteen courses of bricks, the thirteen uppermost courses being two bricks or 18 inches in thickness, and the six lower courses two-and-a-half bricks, or 1 foot 10½ inches in thickness. The sectional area was, therefore, thirteen courses, at 3 inches each, = 39 inches × 18 inches thickness = 702 inches; six courses, at 3 inches each, = 18 inches × 22½ inches thickness = 405 inches, total sectional area 1107 superficial inches, and in the lower courses were inserted (as we understand) fifteen lengths of hoop-iron, 1½ inch and $\frac{1}{16}$ inch.* The beam was supported at each end, leaving a clear bearing of 21 feet 4 inches, and after it had been built about *three months* it was loaded with 11,200 lbs. of pig-iron, placed on

* General Pasley says, in his work "On Limes," five only, p. 162.

a platform, which was suspended at the central part of the beam, which weight was increased at the end of another three months to 24,000 lbs. In this state it was left for twelve months, at the termination of which period it was determined to load it until it broke down, which was effected by increasing the weight to 50,622 lbs.



DIMENSIONS.

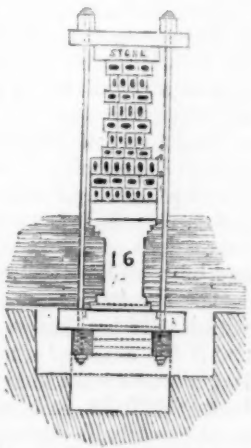
Neat length, 24 ft. 4 in.
" length, 21 ft. 4 in. in clear of piers.
" depth, 4 ft. 6 in.
" thickness, 2 ft. 4 in. bottom, and 1 ft. 6 in. upper part.

Built of equal parts cement and sand; completed, 12th April; centres struck, 22d April.

CONSUMED:

1200 hollow bricks, weight,	10,750 lbs.	
32 bushels cement, 32 ditto sand,	6,400 "	
		17,150
If built in common bricks would require—		
2700 stock bricks, weight,	13,420	
50 bushels cement (Roman,) 50 ditto sand	8,000	21,420
difference,		4,270
Weight of scale and iron work,	1,792 lbs	
" of stone,	672 "	
" of beam in suspension between piers.	15,00	
		17,464 lbs.
In common bricks:		
Scale and stone, . .	2,464	
Net weight of beam, . .	18,743	21,207 lbs.
difference,		3,743 lbs.

=1 ton, 13 cwt. 1 qr. 19 lbs.



Messrs. White and sons had determined, *for the purpose of exhibiting the strength of Portland cement as compared with Roman cement*, to erect a brick beam in all respects similar to the last described (except the substitution of *Portland* for *Roman* cement;) but a short time previously to the opening of the Exhibition, it was suggested to them that if they made

use of hollow bricks instead of the ordinary solid bricks, it would add much to the interest of the experiment (as experiments upon hollow bricks were much wanted;) and in compliance with this suggestion, they erected, a few days before the opening of the exhibition, *a beam of hollow or tubular bricks, with Portland cement and sand (in equal portions,)* with iron hooping in the lower courses, and generally following, in all respects, the dimensions and form of the beam built with Roman cement at Nine Elms, as far as the use of the hollow bricks would permit. The weight was applied in the central part of a clear bearing of 21 feet 4 inches, in the same manner as to the Roman cement beam. The use of the hollow bricks occasioned some difference in the sectional area, which we have to take into account; but we shall disregard in the present comparison the disadvantages arising from having merely the narrow edges of the tubes to connect with the cement instead of the broad surfaces of ordinary bricks.

The Portland cement beam, as will be seen by the accompanying diagrams, consisted of ten courses; the upper part having three courses on edge, and four flatwise, and the lower part two courses on edge, and one flatwise. The bricks were all laid as stretchers, and the beam consequently consisted of a series of forty tubes (the number of bricks in section throughout,) which were open from end to end of the beam. The average size of the bricks was $5\frac{5}{8}$ inches by $4\frac{1}{8}$ inches, and, the rims or sides being about $\frac{7}{8}$ of an inch in thickness, the tubular or hollow parts were each equal to 9 inches super. But with the joints and beds the whole measured in the six upper courses an average of 36 inches $\times$ 17·52 inches, = 621 inches; and in the three lower courses an average of 1.05 $\times$ 26·6 inches, = 439 inches; making a total area of 1060 inches: from this deducting the forty vacuities, or hollow parts, of 9 inches each, = 636 inches, we have as the net sectional area, 700 inches.

By an inspection of the diagram, it will be seen that as the vacuities are distributed throughout the whole depth of the beam, they occasion a loss of strength nearly proportionate to their whole extent, varying of course as their distances from the neutral axis.

On the part of Messrs. White it is argued that the depth of the Roman cement beam being 57 inches, and the sectional area 1107 inches; and the depth of the Portland beam being $52\frac{1}{2}$ inches, and its net area, 700 inches, we shall have $1107 \times 57 = 63{,}099$; and $700 \times 52\frac{1}{2} = 36{,}750$, as expressions of the relative strength of the two beams, supposing they had been built of the same materials.

The *Roman* cement beam (as before mentioned) was broken down with 50,652 lbs., and since 63,099 : 36,750 : : 50,652 : 29,500, it follows that if the *Portland* cement beam had broken down with 29,500 lbs., the two cements would have exhibited equal strength; but, inasmuch as it took 62,800 lbs. to break down the *Portland* cement beam, the experiment exhibited a superiority of *Portland* cement over *Roman* cement in the ratio of 2·128 to 1, or, in round numbers, $2\frac{1}{8}$ to 1. This reasoning, however, is scarcely correct, since it does not take sufficiently into consideration the strength dependent on *disposition* of the material.

From some experiments made upon Portland and Roman cement, where solid bricks were used with each, the superiority of Portland cement

was found to be much greater than this is shewn by experiment,—but when we consider the nature of the structure, and take into account the circumstance of the *Roman* cement beam having been built *seventeen months* before the breaking weight was applied, whereas the *Portland* cement beam had been only erected *five months*, we are not surprised that the experiment with the hollow bricks did not exhibit the full strength of Portland cement. It is to be regretted that hollow bricks were used, as it would have been better to have rested the comparison upon two beams as strictly analogous as possible, instead of complicating the subject with conditions that are extraneous to the immediate inquiry.*

The important part played by the iron bond in this experiment must not be overlooked. Sir Charles Pasley, in his work on cements, describes two beams constructed by him for the purpose of ascertaining, how much of the extraordinary resistance of brick beams built with cement might be owing to the hoop iron bond. These were precisely similar, with the exception that one of them had five pieces of hoop iron bond, and the other none. The latter cracked when the centering was removed, and was broken by a weight of 498 lbs., while the first sustained a weight of 4523 lbs. before it yielded. "The mutual adhesion of the cement and the iron, says that author, is so perfect, that no force can separate them without producing the complete fracture of the brickwork, which is thus resisted by all the tenacity of the iron."

The tensile strength of wrought iron per square inch of section, may be called 27 tons. The mean of Mr. Telford's experiments gave 29 tons, as did some conducted under our own superintendence. Mr. G. Rennie says 24·93, and Capt. Brown 25 tons.†

In the hollow-brick beam there were fifteen pieces of hoop iron bond, one and a-half inch by one-sixteenth of an inch, nearly; namely: four in the first course, four in the second, three in the third, and two in each of the next.‡ The pieces of iron were all broken, except one in the bottom course, one in the second, and one in the top course.

This very interesting proceeding suggests many observations, but we must now pass on to the experiments, also on Portland cement, which were exhibited on the same occasion by Messrs. Robins and Aspdin, of Scotlandyard.

1. A suspended block of cement, $3\frac{7}{8}$ inches wide, and $2\frac{1}{8}$ inchesthick (one month old,) was pulled asunder by 3240 lbs., including the weight of the scale.

2. Sixteen stock-bricks, attached to each other with neat cement, supported at one end, and projecting from the bearing point 3 feet $2\frac{1}{2}$ inches, broke in the eleventh brick with 256 lbs., exclusive of scale, suspended on the extreme end.

3. A solid step, 6 feet 5 inches long, and $7\frac{1}{4}$ inches deep at the back, formed of two parts Portland cement and one part broken bricks, held up at one end, carried itself, and broke off close to the bearing-point when the third 56 lbs. weight (168 lbs.) was placed on the extreme end. The weight of the step was called $4\frac{1}{2}$ cwt.

* Hollow bricks are usually better moulded and more thoroughly burnt than ordinary stocks.

† Eight or nine tons may be considered a safe load-strength.

‡ In the diagram, by mistake, only fourteen are shown.

4. Two blocks of neat cement, 1 foot 5½ inches long, 9 inches wide, 4½ thick, cemented together with neat cement, bore 6000 lbs., when the lower part of the lower block gave way.

5. Twenty stock-bricks, united side by side with cement, composed of one of cement and one of sand, 3 feet 6½ inches in bearing, were supported at each end by iron clamps; the weights being applied to the centre, the bricks broke with 1200 lbs.

6. Six fire-bricks, in courses, cemented together with pure cement, were suspended, and weights were applied to pull them apart; the upper brick broke with 2836 lbs. in the scale.

7. The five fire-bricks from the last trial were again tested, iron being inserted in the second brick from each end; the upper brick broke, carrying away also part of the lower, with weight of 4600 lbs.

8. Two pieces of Portland stone, 2 feet by 11½ inches, 7¾ inches thick, cemented together with neat cement, took a weight of 7272 lbs.; when the lower stone yielded, carrying away a small portion of the cement joint.

Our readers will find other experiments on the same material, both by Messrs. White & Sons, and Messrs. Robins and Aspdin, in our sixth volume, pp. 343, 351, and 471.

For the Journal of the Franklin Institute.

Note on the Tow Boat "America," and her Trial Trip.

A new steam tug, under the above name, has recently been placed upon the Delaware river, by the "Philadelphia Steam Pump and Towing Company," and was tried Dec. 8th, 1851. Her dimensions are, length (between perpendiculars) 133 feet; extreme breadth, 25 feet; depth of hold, 13 feet. She is rigged with two masts, with fore and aft sails to be used in case of accident to her machinery; and is propelled by two vertical direct action trunk engines, with cylinders, having each an effective area equal to 32 inches diameter, and 30 inches stroke, attached to a propeller (true screw) 10 feet in diameter, 26 feet pitch; angle of blades at periphery with a line perpendicular to the axis, 39° 30′; total absolute surface of blades, 61·30 square feet. She has one boiler, of the description known as the Horizontal Return Tubular, having large flues below and tubes above. The fire room is forward.

Her performance on the trial was as follows:

From Navy Yard shears to Chester wharf, 1 h. 53 m. 23 sec., against flood tide; average pressure of steam in boilers, 26¼ pounds; at steam chests, 25¼; average vacuum, 26 inches; revolutions made, 5501; average per minute, 48·5; distance, 16·25 miles; speed per hour, 8·6 miles. During this part of the trip, the "thrust" journal of the propeller shaft gave trouble by heating, reducing the number of revolutions. On the up trip, time from Chester wharf to Navy Yard shears, 1 h. 14 m. 57 sec; steam and vacuum about the same as before. Revolutions made, 3822, or 50·95 per minute. Average speed, 13 miles per hour; tide, flood, as before, and therefore in favor. To find the slip, the velocity of tide must be ascertained

as follows: had the journals not heated going down, 50·95 revolutions would have been made, increasing the speed to 9·04 miles per hour.

Speed coming up was, . . 13 "

Difference . . . . 3·96

Or, average speed of tide per hour, 1·98 miles.

This speed, therefore, on the down trip, acting for 1 h. 53½ m. increased the distance run by . . . . miles 3·740

On the up trip, acting 1 h. 15 m., diminished the distance run by 2·475

Whole increase of distance, 1·265

Distance performed (by shore marks,) . . 32·500

Space absolutely passed over, miles 33·765

$$\text{Then } \frac{33{\cdot}765 \times 5280}{93223 \times 26} = \frac{178280 \text{ feet}}{242408} = 73{\cdot}54$$

and 100—73·54 = 26·46 per cent. mean slip of the propeller. The vessel was drawing 12 feet aft, and 9 feet forward, at the time of the trial.

The performance of the engines was very good, and their workmanship and appearance highly creditable to the makers, James T. Sutton & Co.; the hull was constructed by Vaughn & Lynn.

Note.—On the above trial the brass packing around the trunks became constantly very dry and required great attention. This brass packing has since been replaced by hemp, and (it is stated,) the change has resulted in a gain of 4 to 5 more revolutions over the number obtained on the trial. M.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, December 18, 1851.

S. V. Merrick, President, in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

A Letter was read from Mrs. E. Taylor, informing the Institute that the Collections of Minerals, Scientific Books, and Instruments of her late husband, R. C. Taylor, Esquire, will be held at private sale at No. 48, South Fourth street.

Donations were received from The Royal Astronomical Society, London; The Baltimore and Ohio Railroad Company, Baltimore, Md.; The Chicago Mechanics' Institute, Illinois; The Hon. T. M. Bibighaus and Joseph R. Chandler, Members of Congress; and H. Carey Baird, Charles E. Smith, and Isaac Lea, Esq.'s, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement of the receipts and payments for the month of November was read.

The Board of Managers and Standing Committees reported their minutes.

The Special Committee appointed at the last meeting, respecting the publication by Messrs. Yerger & Ord, of the Report of the Committee of Judges on Surgical Instruments at the late Exhibition, presented and read their report, in which they recommended the following resolution, which was on motion adopted:

Resolved, That the Actuary be directed to announce through the public papers, that no action has been had by the Committee on Exhibitions nor by the Institute, on so much of the report of the Judges on Surgical Instruments, at the late Exhibition, as relates to Artificial Legs and Club Foot Apparatus; and that the publication thereof made by Messrs. Yerger & Ord, is without authority or consent of the Institute, or the Committee on Exhibitions.

Resignations of membership in the Institute (5) were read and accepted.

New candidates for membership in the Institute (21) were proposed, and the candidates (97) proposed at the last meeting were duly elected.

Nominations were made for Officers, Managers, and Auditors of the Institute for the ensuing year.

On motion, it was resolved that the election for Officers, Managers, and Auditors of the Institute for the ensuing year, be held on Thursday, January 15th next, between the hours of 2 and 8 o'clock, P. M., and that seven members be appointed to conduct the election.

Dr. Rand exhibited to the members a new gas burner, which possesses the advantage of great steadiness of light, being the only one yet found sufficiently steady for microscopic purposes, and comparing in this respect with the Carcel lamp. It is a modification of the burner known as the "patent burner," and is the contrivance of Dr. P. B. Goddard, of this city, well known for his accuracy as a microscopist. It consists of the patent burner of the medium size, having the button attached to the central tongue sawn off at the level of the holes, for the admission of the gas, and the outer row of holes for the admission of air stopped up, a cylindrical chimney being used. He also presented one having the outer row of holes left open, which was found on trial to give an equally steady light. Dr. Rand mentioned that he had, with Mr. G. W. Smith and Dr. C. M. Cresson, ascertained the economic value of this burner, by Ritchie's photometer, and gave the result as follows: The two burners were compared with a fish-tail burning 5·7 cubic feet per hour. Its value, as calculated and compared with a standard candle, was 14, that of Dr. Goddard's burner 9·1, and that of the second form of burner 10·4. Thus showing that, as far as the experiments went, the steadiness of the light is at the expense of economy, a result he believed accordant with the general rule in regard to all gas burners. He further remarked, that as the fish-tail was a large one, the result might appear rather too marked against the modified burners, inasmuch as he believed it to be true that the relative economy of bat-wing or fish-tail burners increases in a rapid ratio with their size. The experiments with these and other new burners will be further prosecuted.

Prof. Frazer said he believed that not only did candles of the same size and material burn unequally, but that the same candle burns with different rapidity and amount of light at different times. He had found in his class experiments, that two similar candles lighted at the same time would alternately burn above or below an average line.

Prof. J. C. Cresson, in reply to inquiries, remarked in relation to the standard candle, although it might be true that all spermaceti candles six to the pound did not burn equably, yet it had been convenient to assume that size as a standard. It was also true, that as we reached the maximum of economy in a burner, we rendered the flame more liable to be influenced by slight changes in the supply of air or gas, and thus unsteady. He explained the greater relative economy of large bat-wing and fish-tail burners by the fact, that as the size increases the sheet of gas becomes thicker, and less gas is burned before decomposition.

Prof. Frazer stated that he had found the double cut burner advantageous, as it gave a good, strong light when burned comparatively low, and an economical light at the full head of the gas. He further remarked that this double cut burner was not new, as had recently been claimed.

Dr. Rand further exhibited some oil of resin, distilled by the Pennsylvania Oil Company, at Port Richmond. This Company recently commenced the manufacture of oils from resin, under the patent of Louis S. Robbins, issued November 4, 1851, and they are now manufacturing machinery, paint, and tanner's oil. These are made by the same process as those of the New York Company at Brooklyn. The specimen presented was intended as a lubricating oil, and is represented by the manufacturers to possess decided advantages over any other oil now in use for this purpose. It is also represented as not liable to congeal, or to inflame with cotton.

Mr. G. W. Smith drew the attention of the meeting to the subaqueous method of removing rocks at Hell-gate and other places in the harbor of New York, under the direction of M. Maillefert, by the direct application of canisters of powder to the surface of the rock, without the intervention of drilled holes, although the latter had in a few instances been resorted to. Mr. S. alluded to the previous efforts in subaqueous blasting, made in Europe and elsewhere, and described the great waste of force in the method of M. Maillefert, stating that the whole force expended in elevating the water to a vast height in the air was wasted, and that the method never should be resorted to where drilling was at all practicable, and deprecated the proposed introduction of a method, moreover not new in itself, to the blasting of rocks in the Delaware and Schuylkill rivers.

Mr. G. W. Smith presented the statistics of all the Coal mined in the State of Pennsylvania, both bituminous and anthracite, including not only the amount sent to market, but also the local consumption by families, by manufacturing establishments in the coal regions, &c. The amount of anthracite is nearly 4,900,000 tons for the present year, 1851, and of bituminous nearly 2,400,000 tons. The data as to the latter he stated would require some revision, and the total statement of the amount will appear in a subsequent number of the Journal. Mr. S. begged the meeting to consider that the *production* of coal in Pennsylvania was nearly three tons for every man, woman, and child of the whole population of